Protecting Transmission Line Telephones*—*Graphical Analyses of Plant Investment, Operating Costs and Revenue Together with Other Engineering Articles on Station and Operating Practice

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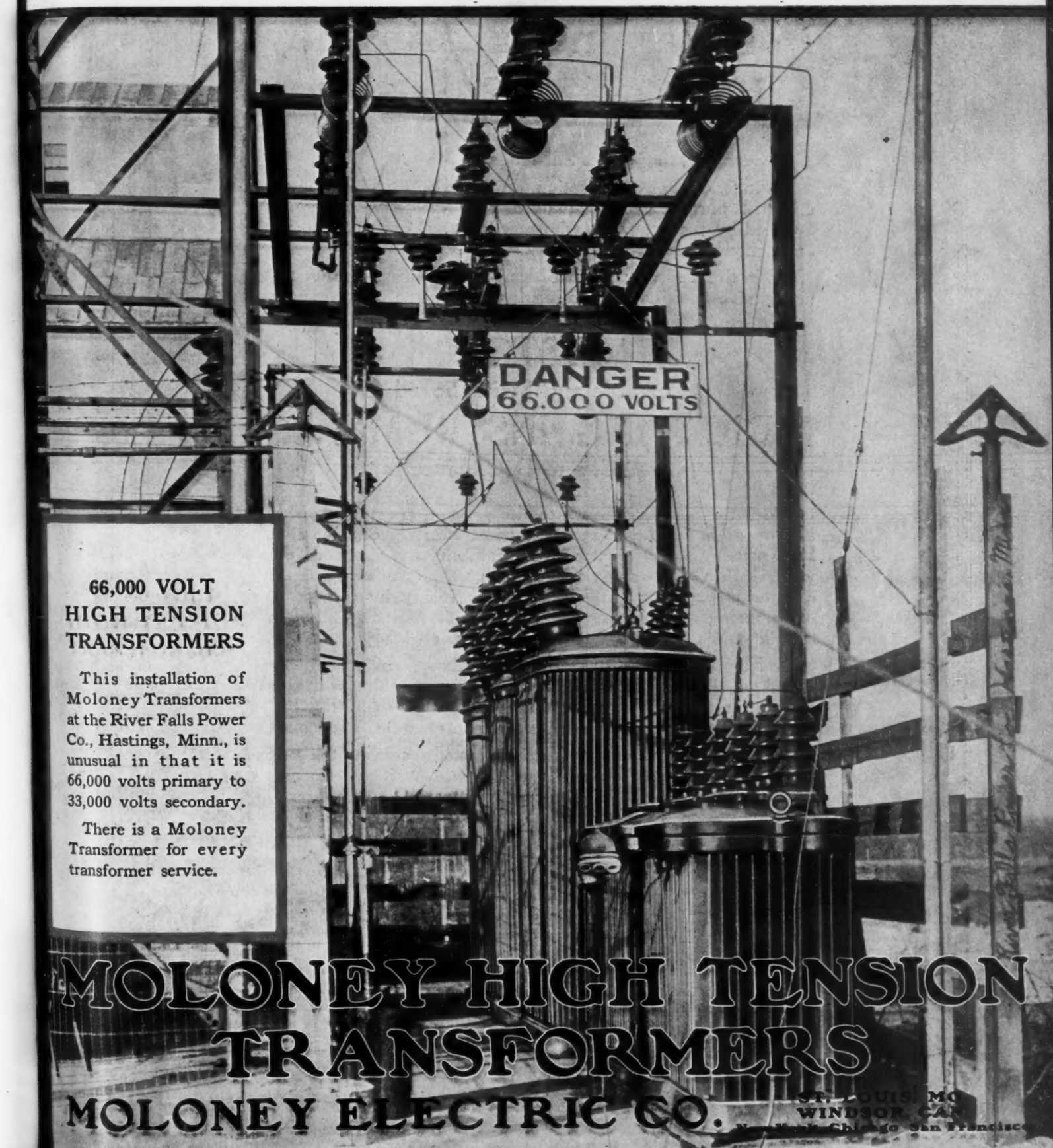

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Making the Invested Dollar Nimble

SCARCITY of raw materials, like scarcity of money, has its unexpected advantages. It leads to economy. It spurs effort to make existing plants operate at the highest efficiency. It encourages the development of substitutes. When a larger volume of business is done with the same plant we learn how to make the dollar of capital more nimble. If this practice is continued, not only for a brief spell of acute demand, but for, say, two years, the knowledge which it develops will assure permanent progress in the economical use of existing investment. That is what has taken place in the electrical industry. In central stations the great enlargement in public requirements of energy and the difficulty of getting equipment promptly have combined to develop extreme care and the fullest possible utilization of properties. Continued growth at the present fine rate of expansion and reduced outlays for new plant give attractive financial results. Similarly, the manufacturers are attaining a highly desirable level of output. Ultimately these conditions will produce a policy of enlargement which will be in keeping with the greater scale of demand that the future promises.

How to Lower Rates

OCCASIONAL rate reductions have an advertising value which the central station executive should not ignore. They are news for the dailies, they stimulate consumption from old customers and they attract new applicants. So long, therefore, as it is practicable to lower rates from time to time there is a commercial as well as a public policy reason why it should be done. Larger output reduces average cost, the load factor improves and the natural growth of business helps to overcome the net effect of the modified schedule. In contrast with this general plan, which is followed by many managers, there is the policy that seeks adherence to a fixed maximum rate for a definite period. Although that policy does not carry the stimulus to new business which results from occasional rate revision, it permits the manager to gage the development of his business pretty accurately for the period agreed upon. Furthermore, it lessens the worry of rate-making. In both of these policies there is an admitted need of rate reduction as volume of business increases and economies are perfected, the only question being as to the time and frequency of the reductions. From the standpoint of pleasing the public occasional reductions are an advantage because they are more likely to be voluntary than forced. On the other hand, some of the utilities have to deal with politicians who will be dissatisfied if they are not allowed to stage a case in which they grasp concessions for the people from a writhing monopoly. Evidently the line of policy governing the central stations is a matter for judgment according to the facts in each community. And rates cannot go down forever.

Regulation Up to Date

WHEN the reformers began to reform they told us that public utilities, under beneficent regulation, would lead beautiful, care-free lives. Their investment would be determined by valuation, rates would be based on cost, service would be fixed by rules and regulations. All that they would be called upon to do would be to enjoy their guaranteed monopoly, to collect from glad consumers and to remit to happy, protected stockholders. It is somewhat appalling to find that this program, idealistic as it appeared to be, failed to take into precise account the question of relations with labor. To be sure, labor cost is a part of total cost, and total cost, it was confidently assumed, would be met by the willing users of service. But the spectacle which has been presented at Washington is that of a government deliberately seeking to add heavily to cost without definite acknowledgment of the obligation which this should impose. Regulation may imply in general legal irresponsibility for its acts, but it cannot escape moral responsibility. The policy of fair regulation, with which the country started, becomes the deliberate policy of unfair regulation when it adds heavily to cost without a revision of the only means by which cost can be balanced. Clearly, we need to study carefully the lines on which regulation is progressing, for the pitfall of interference in labor conditions is deep. In the interest of permanent success for the policy, we cannot minimize the danger which the federal attitude brings.

Losing Export Trade

BY foresighted business men generally it will be regarded as most unfortunate that the Senate in its last-minute haste killed the bill providing for co-operation in export trade. Here was a constructive measure which received widespread approval and little disapproval. The President favored it, the Federal Trade Commission repeatedly impressed the importance of such legislation. Yet Senator La Follette, by threatening a filibuster if this legislation was attempted, forced the majority party leaders to abandon it. If the Senate had used less time legislating at the behest of the

railway labor leaders it would have had more time for fair consideration and passage of a bill which would have helped the country at large. Having dissipated its days in trying to legislate higher wages into the statutes regulating railways it scrapped the unspectacular bill for export associations. Why should bills behind which votes lurk be compared with bills which are wanted by mere chambers of commerce, boards of trade and other business organizations? There is a plain economic reason why the United States should have a law giving perfect legality to export combinations which may compete with the export combinations of Europe. Therefore, when the Senate has more leisure it will probably follow the action of the House of Representatives in enacting the necessary legislation to promote this end. But it could have prevented lost time and opportunities by acting now. Every day brings nearer the time when the American manufacturer must meet strong competition from Europe.

Transmission-Line Telephone Troubles

IT is very hard for alternating-current power transmission lines and telephone lines to exist, in mutual good will, on one and the same set of poles. The power wires are very apt to make the telephones unworkably noisy, as well as dangerous to handle. The telephone wires may also constitute a risk of crosses or short-circuits for the power wires. Nevertheless, it is very important to have telephone communication alongside a power transmission system, in good and safe working order. The steps that should be taken to bring about this condition with the telephone lines suspended from the power-line towers are already known; but the steps taken to standardize such telephone line installations are not generally known. Such standardization is clearly described in the article by E. P. Peck found in this issue, as worked out for a large power-transmission and distribution system, employing various line voltages and types of aerial line construction. It will be seen that the telephone line protection used involves a number of elements, in all, among them being fuses, drainage coils, gaps, and vacuum-tube protectors. The arrangement however, is quite simple and effective as indicated by the author in his remarks on operating results.

It is significant that when the telephone lines are under the same management and control as the power lines these carefully standardized and detailed systems of protection are found to be necessary, in order to produce safe and quiet telephone service, on a relatively very small number of telephone circuits. It can be readily imagined how much more difficult it would be to protect, in a similarly effective way, a large number of parallel telephone lines, on the same poles as a long high-tension power line, especially when the management and control of the power and telephone systems are not in the same hands. The inference is that overhead telephone lines should seek to avoid closely paralleling long high-tension power lines, if peace and serenity are to prevail between the respective owners.

Looking Into the Future

IT is abundantly evident as a result of the great war, that, whichever way peace comes, the *post-bellum* world will be noticeably different from the *ante-bellum* world. In some ways, no doubt, we thankfully confess that it will be a better world. In other ways the change will not be beneficial. We must face the facts of the change as contentedly as we can. A great number of fellow-workers will have gone. A large amount of capital will have been destroyed. The accumulations of many years will have been spent. The world, as a whole, will be less well off than before, and the struggle for a comfortable existence will be harder. Nevertheless, if envy, malice and race hatred can be replaced by good-will, thrift and hearty co-operation, the loss may be greatly reduced. The possibility lies open to make up, in moral and spiritual values, for some of the material loss although it will have reached tremendous proportions.

We in America, who have thus far escaped the swath of war conflagration, cannot hope to escape thereby the aftermath of its turmoil and distress. The globe is too small, and we human beings are too closely associated on it, to prevent the distribution of good and ill. We may escape a large share, but a share we must take. On the purely material side, we must expect a considerable rise in the cost of living, which is only another way of saying that the average individual wealth must be expected to diminish.

It lies before us in America to take this relatively small share of the world's distress cheerfully and bravely. If we do, its ill effects will be almost averted. If, on the other hand, we accept that inevitable bitterly, we shall deserve to suffer doubly. If envy, class contention, strikes, lockouts and business war win the day, we shall all have to drink the bitter cup more deeply. If we charitably and cheerfully turn to work and thrift we shall almost lose the bitter taste in the joy of the effort.

In electrical engineering there is great hope of general betterment. Every advance made in the knowledge of electrical science, and in the application of electric arts, enriches the community, the country, and the world. We want to stimulate inventors to new achievements, and to see that their successes are well rewarded. We want to have capital encouraged to take up enterprise in what the engineers can safely attempt, and to have that capital well rewarded. We want to see men employed in new electrical businesses that will pay, and to see these men well paid for their work, and their managers amply rewarded for success. All this means good-will, hard work, enterprise, savings and thrift. It does not mean the throwing up of obstacles that will hamper business through legislation nor the creation or stimulation of conditions that will set class against class.

The technical colleges and universities will shortly resume their work in class rooms and laboratories. Collectively, much good can be expected from their researches. All earnest research is good, whether in the

field of pure science, engineering, or commercial electricity. It all helps to overcome the wastes of war, strikes and hate. Here, a new discovery may lay the foundation for future applications. There, engineering principles may be simplified and made more serviceable. There, again, industrial processes may be simplified, improved, and in many ways cheapened. Productive research work of some kind is needed, and in order to make it most effective should be organized and carried out co-operatively.

Substitutes for Oil in High-Tension Switches

AN article is referred to in the Digest section of this issue, which appeared recently in the *Elektrotechnische Zeitschrift*, by M. Vogelsang, and deals with some experiments with carbon tetrachloride, or benzinoform, as a liquid insulator surrounding high-tension switches, in place of insulating oil. The suggestion originated in France some years ago. Oil, as we all know, is a very effective insulating fluid for high-tension switches, but is subject to certain defects. It is very deliquescent, and, if exposed to moisture-laden air, will in time absorb enough water to reduce its insulating properties materially. Oil also evaporates slowly, and its presence in large quantities necessarily involves a certain amount of fire risk. A non-inflammable, equally good and cheap insulating liquid, which had no countervailing defects, would therefore be well received both by makers and users of the apparatus.

The experiments described on benzinoform indicate that it is a non-inflammable insulating liquid, capable of being used as a substitute for oil; but possessing peculiar disadvantages of its own, which seem likely to stand in the way of its use. It boils at 76.5 deg. C., and at ordinary temperatures is very volatile in air—much more so than oil. Moreover, if it leaks out of a switch chamber it disappears completely by evaporation, and, therefore, gives no warning evidence of escape; whereas, when oil similarly leaks, it makes a far spreading telltale stain on the floor. The article suggests that an admixture of one volume of carbon tetrachloride to three of oil, produced a liquid insulator less inflammable than unadulterated oil, and not nearly so volatile as unadulterated carbon tetrachloride. Whether a mixture such as is indicated would or would not meet with practical success, there is a good opportunity for electrochemists to discover a new, efficient cheap liquid insulator. It can hardly be believed that in the great storehouse of the chemical-available universe, all the good liquid insulators are already known or even the fairly satisfactory ones sufficiently investigated.

Lighting Conditions in American Cities

THE table which we presented last week puts in convenient form the public lighting data from more than 100 American municipalities, including the number and kind of lamps used, the service rate per year and the date when the present equipment was installed. It affords in very compact form a great mass of valuable data for the consideration of the engineer and of civic authorities. At a casual glance the most striking single fact disclosed is the practical suppression of the older types of arc lamp, which have been replaced either by flaming or luminous arcs of high efficiency, or by gas-filled incandescent lamps. Even the long-burning flaming arcs and the smaller magnetite arcs have felt the pressure of the change in the art, and there is a tendency to replace them either by luminous arcs of higher power or by incandescents, usually of the 600-cp. size. Ornamental lighting both with arcs and with incandescents is on the increase, and there seems to be a wholesome tendency toward the use of large units rather than smaller units in groups. A few cities have gone over entirely to incandescent lamps, with more in prospect, so that the indications are very strong toward the opinion we have oftentimes expressed that only the very biggest and most efficient types of arc can survive the competition.

The service rates, as given, are a curious mixture indeed, and their variations lend point to the substitution for the usual contracts of a more logical form, perhaps something after the style of the one described in last issue. Local conditions of strategy often make extraordinary variations in the price charged for street lighting service, which are sometimes manifest in irregular shifts of price which would tend to eliminate certain sizes and kinds of lamps. The differences in cost between all night and midnight lighting, too, sometimes strike one as very singular and so they are, yet this particular matter may be so mixed up with the question of underground versus overhead distribution that the data cannot properly be interpreted. The figures presented are well worth special investigation by those particularly interested in the matter of prices, and will serve as an excellent basis for a study of comparative conditions and as a plain indication of the very evident drift of present practice.

The Coming Issues

NEXT week's issue of the ELECTRICAL WORLD will as usual deal largely with general engineering problems and with investigations of a scientific and research character. A rather extensive article in this number will take up results of a study of the phenomena attending non-synchronous rotary-gap operation in wireless telegraphy. In the commercial number of the following week, issued under date of Sept. 23, a leading article will point out reasons why American electrical manufacturers should develop export business. Other articles treating on broad commercial and trade extension topics will appear in this issue, accompanied by the regular departments for the engineer and operating man. The third number of ELECTRICAL MERCHANDISING, the new monthly magazine which extends to the trade the editorial service of the ELECTRICAL WORLD, will be issued on Sept. 15.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

JOINT CONVENTION AT SEATTLE

President Buck, Before A.I.E.E. and Northwest Electric Association, Pays Tribute to Western Engineers

The ninth annual convention of the Northwest Electric Light and Power Association and the annual Pacific Coast convention of the A.I.E.E. were held jointly this week at Seattle, Wash., with many representative men in attendance from the principal Coast centers. An unusually full and profitable discussion of papers was held.

Features of the first two days' sessions were the detailed discussion of transmission-line insulator failures and the clear explanation of remedial measures adopted by telephone companies against inductive interference. The methods used proved highly satisfactory to representatives of both the telephone and transmission-line interests, and power company engineers pronounced the paper and its discussion on the convention floor the greatest advance yet made toward effective co-operation in this respect. A complete report and a review of the discussion of the principal papers is planned for next week's issue.

ADDRESS OF PRESIDENT BUCK

H. W. Buck, president of the A. I. E. E., and Ralph W. Pope, honorary secretary of the Institute, were present. In his address President Buck emphasized the tendency of the Institute to get away from "the New York idea," or the centering of Institute activities in the East. Such gatherings as that at Seattle, held in different parts of the country, where common problems are discussed, fulfill, he said, the highest destiny of the national organization. President Buck commended the progressive spirit that characterizes engineering in the West and declared that the East is recognizing how much this has advanced the science and is acknowledging it with gratitude.

Referring to the fact that engineers seldom get their deserts in public estimation, he urged that prejudice be set aside and that engineers seek to acquire a broader view of public affairs and take a more active part in public life. President Buck placed special emphasis on the urgent need for the Institute to work on the problems of better transmission-line insulators. He expressed the view that many lightning and surge troubles would never appear if it were not for weak insulators. The great need for improvement is obscured, he said, by the reticence of power companies about their failures and the refusal of the manufacturers to admit the actual status of the situation.

OVERHEAD CONSTRUCTION

A paper on "The Application of Overhead Line Construction Rules of the Public Service Commissions of the Northwest," by M. T. Crawford of the Puget Sound Traction, Light & Power Company, Seattle, presented a brief discussion of the principles involved and the results obtained by the adoption and enforcement of rules covering the details of overhead line construction. Data were given on the effect of the present rules on the cost of line work and the extent to which the rules have been complied with. Examples of line construction standards which conform to the rules were shown and their specifications given.

"Adequate Protection Against the Risks of Obsolescence and Inadequacy," was the title of a paper by Leslie Craven.

COMMERCIAL TOPICS

In their papers on "Merchandising and Operating in Small Towns and Rural Communities," Lewis A. McArthur of Pacific Power & Light Company, Portland, Ore., and W. F. Farquhar, of the Washington Water Power Company, Spokane, Wash., related how the two companies conduct business in the many small towns in the states of Washington, Idaho and Oregon in which they operate. The authors gave in detail the operating, accounting and new-business methods employed, which should be of interest to the managers of all small companies.

The report of the electric range committee was presented by W. R. Putnam, chairman, who gave a brief résumé of the discussion of the range committee's report at the Commercial Section of the N. E. L. A. at the Chicago convention in May.

I. E. S. Convention Papers

A list of the papers to be presented at the tenth annual convention of the Illuminating Engineering Society to be held in Philadelphia, Pa., on Sept. 18, 19 and 20, at the Bellevue-Stratford Hotel, follows:

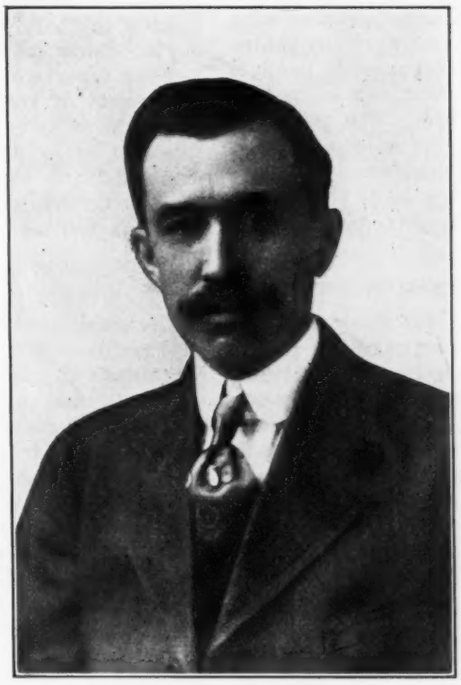
"Colored Glasses for Illuminating Engineering," by Dr. H. P. Gage, Corning Glass Works, Corning, N. Y.; "Lighting of Cleveland Museum of Art," by Dr. E. P. Hyde, physical laboratory, National Lamp Works, Cleveland, Ohio; "Illuminating Engineering Photographs," by B. H. Norris, Illuminating Engineering Laboratory, Schenectady, N. Y.; "The Effects of Brightness and Contrast of Vision," by Dr. P. G. Nutting, Eastman Kodak Company, Rochester, N. Y.; "Apparent Brightness and Its Properties," by Dr. L. T. Troland, physical laboratory, National Lamp Works, Cleveland, Ohio; "Integrating Spheres," by F. A. Benford, Jr., Illuminating Engineering Laboratory, Schenectady, N. Y.; "Street Lighting," by Ward Harrison, National Lamp Works, Cleveland, Ohio; "Gas and Electric Lighting in the Home," by C. H. French and C. J. Van Giesen, Public Service Electric Corporation of New Jersey; "Optic Projection as a Problem in Illumination," by J. A. Orange, Research Laboratory, Schenectady, N. Y.; "Forced Life Testing on Incandescent Lamps," by L. J. Lewinson, Electrical Testing Laboratories, New York City; "Industrial Lighting by Gas," by J. D. Lee, United Gas Improvement Company, Philadelphia, Pa.; "Gas Illumination of the Philadelphia Civic Exposition," by C. S. Snyder and F. H. Gilpin; "Experiments on the Eye With Pendent Reflectors of Different Densities," by Drs. C. E. Ferree and G. Rand; "Studies of Economics in Office Building Lighting," by S. G. Hibben, consulting engineer, Pittsburgh, Pa.; "Recent Developments in Prismatic Glassware," by G. W. Roosa and H. L. Jenkins, Holophane Glass Company, Inc., Newark, Ohio; "Probability Curves as Applied to Photometric Measurements," by W. G. Housekeeper, Western Electric Company, New York, N. Y.

EDISON ASSOCIATION AT HOT SPRINGS, VA.

Problems of Utility Management Discussed in Executive Session—Many Leaders of the Industry Present

Papers and discussions at the thirty-seventh annual convention of the Association of Edison Illuminating Companies this week forecast the problems of the electric utilities in operating, sales and public policy for the year to come. The convention this year was held at Hot Springs, Va., and the business program, as is customary, was varied with special entertainment features, in which golf for the men and dancing for the ladies were the popular attractions.

Representative men of the electrical industry were in evidence at the meetings and on the golf course, including Walter F. Wells of Brooklyn, president of the association; Charles L. Edgar of Boston; Arthur Williams of New York; W. W. Freeman of Cincinnati; John W. Lieb of New York; Thomas E. Murray of New York; Peter Junkersfeld of Chicago; E. W. Rice, Jr., of Schenectady; Guy E. Tripp of Pittsburgh; Alex Dow of Detroit; E. W. Lloyd of Chicago and H. A. Wagner of Baltimore, president of the National Electric Light Association.



PETER JUNKERSFELD
President-elect Association of Edison Illuminating Companies

PRESIDENT WELLS' ADDRESS

President Wells in his opening address called attention to the broad business phases of the central-station industry, making it clear that the tendencies in governmental relations with business in general touch intimately the problems of central-station management. He pointed out that the central-station companies now have the opportunity to invest capital which may be called for in Europe when the war is over and that they should take advantage now of making extensions calling for new capital.

REPORTS OF COMMITTEES

The business sessions were executive and papers and reports were printed, but not published. The association for the year had nine standing committees: the committee on incandescent lamps of which John W. Lieb is chairman; meters O. J. Bushnell of Chicago, chairman; electric plant, R. F. Schuchardt of Chicago, chairman; steam plant, J. W. Parker of Detroit, chairman; production costs, W. H. Lawrence of New York, chairman; residential rate service, Alex Dow, chairman; committee on standards, to confer with the National Bureau of Standards, J. W. Lieb, chairman; street lighting, J. W. Cowles, chairman; utilities publication committee, E. W. Burdett of Boston, chairman.

Reports of these various committees were presented at the business sessions, and in addition papers and lectures were delivered.

COMMISSION REGULATION TOPICS

Two papers, one by R. S. Hills entitled "Distribution of Public Utilities Reports," the other "Keeping Up With the Commissions," by Henry C. Spurr, and a lecture "The Nitrogen Industry as a Power Load," by D. B. Rushmore, were given at the first business session.

On Tuesday evening W. A. Durgin of Chicago presented his lecture on "Better Lighting; Its Possibilities for Customers and Central Stations." Mr. Durgin's lecture was an illustrated example of the methods of selling light instead of lamps, and the general advantages of such a policy were emphasized in the executive sessions by Peter Junkersfeld of Chicago in a paper entitled "Control of Lamp Service by Central Stations," and a memorandum by Miss S. M. Sheridan of Detroit, "A Change of Type of Lamps Supplied to Residences."

On Wednesday the "Use Factor in Residential Rate Making," by Louis A. Ferguson, and "Sales to Isolated Plants" by R. S. Hale developed special phases of rate making.

MANUFACTURING CONDITIONS DISCUSSED

Addresses by E. W. Rice, Jr., president of the General Electric Company, and Guy E. Tripp, chairman of the board, Westinghouse Electric & Manufacturing Company, were also delivered. Mr. Rice and Mr. Tripp brought out the general situations between supply and demand for material and labor, which has been so extraordinary during the past year, and which has complicated the manufacturing situation in meeting deliveries.

Messrs. Rice and Tripp made clear in their addresses the fact that the munition orders taken by their respective companies had not materially influenced the handling of domestic business and that the present necessity for long delayed deliveries and advances in prices is due to (1) shortages in raw materials; (2) a scarcity of two grades of labor, one the very skilled and the other the most unskilled; and (3) delays in getting deliveries on their own orders of machine tools.

ELECTION OF OFFICERS

Peter Junkersfeld of Chicago was elected president and L. L. Elden of Boston was elected vice-president of the association for the coming year.

Peter Junkersfeld, the president-elect of the Association of Edison Illuminating Companies, is assistant to the vice-president of the Commonwealth Edison Company of Chicago, a position which has large responsibilities in connection with the company's engineering work. Mr. Junkersfeld was graduated from the University of Illinois in 1895 and shortly afterward joined the operating staff of the old Chicago Edison Company. Advancing to the engineering department, he was in 1906 appointed electrical engineer of the company, and he has held his present post since 1909. Mr. Junkersfeld is a fellow of the A. I. E. E. and has been active in the work of the N. E. L. A., the A. S. M. E., the Western Society of Engineers, and other engineering organizations.

ELECTRIC PLANT OPERATING TROUBLES

The reports presented covering electric plant and steam plant problems and developments were especially interesting and contain a large amount of valuable information and data. The main points discussed are abstracted in what follows.

The report of the committee on electric plant presented results of inquiries concerning operating prob-

lems that are still causing member companies serious trouble either by interfering with a high quality of service or by preventing a full and efficient use of the investment in any part of the system. The information given shows the trend of present practice in the elimination of these troubles, as secured from thirty-five members of the association. The information was classified and presented under the headings of "Outside Plant," "Inside Plant" and "General."

Under "Outside Plant," lightning was shown to be the main cause of trouble on overhead lines and the results of recent extensive experiments were referred to. Underground cable experience and problems were given with discussions and test data. A suggestion for a standard form of report for cable failures as a means to improvement was presented. Under "Inside Plant," problems and experience relating to apparatus in stations of substations were covered. Present practice with reference to the use of reactors by member companies was given in detail and several unusual cases of trouble. Some recent developments in equipment and in the operation of apparatus were described. The principal items discussed under "General" refer to some of the newer problems which operating engineers are now having to meet because of the extension of the use of electricity in the various industries, principally in the iron and steel industry.

Operation and Design of Steam Plants

The report of the committee on steam plant consisted of a series of discussions on particular phases of steam plant operation and design which are representative of actual problems coming up from time to time for solution. Reports from manufacturing companies on recent developments were omitted this year and reference made to details as presented in the prime mover report of the National Electric Light Association. The fifty-three pages of the report are, therefore, filled with information relating strictly to plant operation.

The method employed by the Philadelphia Electric Company in training its men for operating positions, and the plan of organization in their main generating plants, was outlined. A table gives operating results for the Connors Creek plant at Detroit, for the month of July, 1916. An analysis by means of steam flow meters, separating turbine room from boiler room results showed an over-all boiler efficiency for the month of 77.7 per cent. Attention was called to the apparent neglect of adequate ventilation in a great many plants.

In view of a rather general impression that boilers will in the future be operated at evaporation rates greatly in excess of those at present obtaining, considerable attention was paid to present and proposed practice in this respect. The discussion tends to show that evaporation rates averaged for the total heating surface, including economizers, are not likely with standard equipment, to increase much above those at present maintained in a number of plants. Comparison was made of two quite different schemes for controlling combustion in boiler plants, illustrating the results obtained with charts of recording instruments employed. A third method of control was described as worked out by the boiler engineers of another member company.

Results were also given of a study comparing several well-known schemes for obtaining energy for operation of auxiliary machinery and for heating the feed water. It was shown that the over-all plant efficiency may be appreciably affected by the arrangement. A discussion of some causes of boiler tube failures was contributed by Prof. A. E. White.

The convention closed with a banquet on Thursday evening. Many of those in attendance finished the week-end with golf and riding.

PENNSYLVANIA ELECTRIC ASSOCIATION CONVENTION

Proper Presentation of Utility Viewpoint Has Resulted in Equitable Laws and Prevented Discrimination in Pennsylvania—Association Now Serves 95 Per Cent of Population Using Electricity

The ninth annual convention of the Pennsylvania Electric Association, the oldest and largest geographic section of the National Electric Light Association, opened at Eaglesmere, Pa., on Wednesday of this week. Official activities began with the reception to President Stephen C. Pohe, of Bloomsburg, Pa., on Tuesday night, which was a gala and very enjoyable affair. The program was arranged so that those interested in certain phases of central station work would find all appertaining to that branch at one session. Thus Wednesday's session, aside from the address of the President and the reports of standing committees, was devoted to statements of record and accounting, Thursday morning's session to commercial topics, the afternoon executive session to questions of public policy and management and the Friday session to practical operating topics. Entertainment features in abundance were provided as well as an excellent exhibit of electrical apparatus.

Address of President Stephen C. Pohe

The feature of Wednesday's session was the address of President Pohe and the recommendations therein contained. Legislation calling for state inspection of electrical installations was strongly urged in view of the present vulnerable position of utilities with reference to the underwriters. The utilities are practically the only existing means for the underwriters to use in enforcing observance of the National Electrical Code, but in enforcing insurance rules the utilities, it is felt, assume too much of a legal responsibility. The need of watching legislation carefully was also emphasized since it has been found that a proper presentation of the viewpoint of public utilities has invariably resulted in the enactment of just and equitable laws and frequently has prevented burdensome discrimination.

During the year the association has secured the services of a prominent secretary, H. M. Stine, whose office is located at Harrisburg, and his activities in facilitating the work of the member companies before the Public Service Commission and other legislative bodies has shown the wisdom of having a competent man located at the seat of government. The membership of the section is now 1834, ninety-eight of which are Class A members. The members of the association now serve 95 per cent of the total population of Pennsylvania reached by electric lighting companies.

Two papers "Construction of Cost Accounting," by F. Heinbokel of Warren, Pa., and "Classification of Materials and Supplies," by W. P. McArdle of the Duquesne Light Company of Pittsburgh, were read at the Wednesday session but discussion was postponed until the Thursday session owing to the absence of the author of the third paper in the symposium of accounting papers. Important committee reports presented were those on accounting, safety and welfare and geographic sections.

Discussion of Commercial Subjects

The heavy work of the convention was taken up on Thursday when the following papers were presented:

"Method of Securing Consumers Deterred by First Cost of Wiring," by E. C. Newman, West Penn Power Company; "Rate Research," by W. J. Norton, member rate research committee N. E. L. A.; "Increased Use of

Electric Ranges and Small Appliances in the Home," by H. W. Reed, Altoona; and addresses by George B. Muldaur, traveling secretary National Electric Light Association; and W. H. Blood, the latter on the National Safety Code.

In addition the following committee reports were submitted. Geographic sections, by E. D. Dreyfus; municipal street lighting, by E. H. Davis; engineering, by G. E. Wendle; special, by E. L. Smith; rates, by Henry Harris.

Mr. Newman's paper pointed out the necessity of adopting systematic methods to secure residential business, particularly of the older buildings not now wired. In addition some of the more successful plans adopted by various companies were reviewed such as the deferred payment plan, limited time offers, reduced cost for wiring, and so forth. The reason for success or failure of some of these plans was discussed and suggestions were made as to the conduct of campaigns of this character.

In the paper by Mr. Reed it was pointed out that it may be profitable for central stations to sell small appliances, at cost or less than cost. The problems of the electric range and water heaters as utilities were taken up and solutions offered for them. Methods of advertising and exploiting all appliances were discussed in detail.

Engineering and Operating Topics

The engineering and operating topics discussed on Friday included papers on "Testing of Current and Potential Transformers," by W. A. Fogler, Philadelphia Electric Company; "Boiler-Room Operations," by H. H. Wilson, Harrisburg Light & Power Company; "Hiring and Placing Men Under Standardized Working Conditions," by J. F. Martin and H. N. Müller, Duquesne Light Company; and "Simplified Costs and Factors in Underground Distribution," by W. H. Keating and H. N. Müller, Duquesne Light Company.

Mr. Fogler's paper dealt with a new method of testing instrument transformers for ratio and phase angle. The method depends upon the comparison of a transformer of unknown constants with one of known constants; *i.e.*, with a standard transformer. The transformers are so interconnected that the differences of their voltages or currents are the measured quantities. On account of measuring differences instead of total quantities, it was pointed out, the accuracy obtainable and ease of reading are both greatly increased as compared with any method in which the total quantities must be read directly. A short explanation of the theory involved, test connections, and working formulas was given, together with sample test results and curves procured by the use of the method. Similar test results for the same transformers, procured by other methods were given also as a check upon the accuracy obtainable.

Among the subjects discussed in Mr. Wilson's paper were the desirability of keeping just sufficient boilers in active service, the forcing of these boilers at high capacity, the necessity of cleanliness both inside and outside, the proper cleaning of fires and removal of ashes, the importance of keeping the boiler settings and the entire equipment in repair, the importance of maintaining the proper relation between thickness of fire and draft intensity, and the benefit to be derived from the proper use of the feed water heater were treated as fully as the scope of the paper would permit. The author referred to automatic and indicating devices and the importance of their use and proper operation. The personnel of the boiler room and the desirability of making the work attractive and the increased efficiency of operation obtained thereby were shown.

In the paper by Messrs. Martin and Müller attention was called to the desirability of applying the same principles and effort to the building up the personnel of an organization as are applied to the building up of the physical plant. In addition a résumé was given of the methods used in one case in selecting employees and in determining that the employee is fitted for the particular work, rather than endeavoring to fit the work to the employee. The methods of educating and training the employee, together with the basis of classification of wages and the rewards for ability and for length of service were covered, and also a list of the duties applying to the several classifications.

New York Meeting of American Electrochemical Society

The fall meeting of the American Electrochemical Society will be held in New York City from Wednesday to Saturday, Sept. 27 to Sept. 30, in conjunction with the second national exhibition of chemical industries which will be held during the whole week of Sept. 20 at the Grand Central Palace. The hotel headquarters of the American Electrochemical Society will be at the Hotel Astor, Broadway and Forty-fifth Street. The Wednesday morning session will be held at the Grand Central Palace. On Thursday and Friday mornings the sessions will be at the Hotel Astor, and the Saturday morning session will be on the steamer Olympic.

Social Features

Wednesday will be "Electrochemical Day" at the exposition, Grand Central Palace. The afternoons of Thursday and Friday have been set aside for the inspection of exhibits at the Palace. On Thursday evening a complimentary smoker will be held at the Hotel Astor, to which the members of the American Chemical Society and all other visiting chemists and engineers will be invited. On Friday evening a subscription dinner will be held at the Waldorf-Astoria under the auspices of the American Chemical Society, to which the members of the American Electrochemical Society are invited. For Saturday, Sept. 30, an all-day complimentary excursion of the American Electrochemical Society up the Hudson is planned.

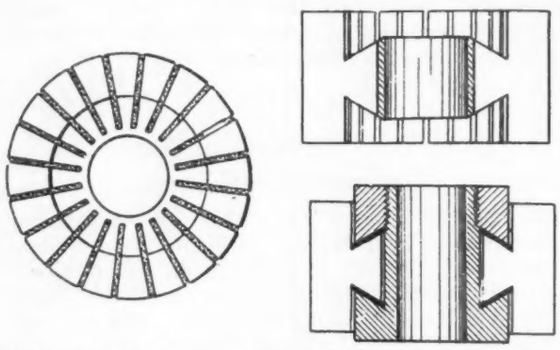
Technical Program

"The Protection of Iron by Electroplating," by O. P. Watts and P. L. DeVerter; "Atmospheric Corrosion of Commercial Sheet Iron," by E. A. and L. T. Richardson; "The Electrolytic Recovery of Lead from Brine Leaches," by O. C. Ralston and C. E. Sims; "Electrolytic Zinc Dust," by H. J. Morgan and O. C. Ralston; "Electrolytic Behavior of Tungsten," by W. E. Koerner; "Electrolysis of Vanadium Salts," by S. Fischer; "The Electrodeposition of Nickel," by L. D. Hammond; "Current Efficiencies in Nickel Plating Baths With Rotating Cathodes," by F. C. Mathers and E. G. Sturdevant; "Deposition of Copper in Electrotyping Baths," by W. Blum.

Friday.—"Characteristics of Small Dry Cells," by C. F. Burgess; "Effect of Temperature on the Performance of the Edison Storage Battery," by L. C. Turnock; "High Temperature Heat Developed During Electrolysis," by Carl Hering; "The Possibilities of Developing Super-refractory Materials for Incandescent Lighting," by F. A. Fahrenwald; "Composition of the Ionization Currents Due to Equal Quantities of Radium Emanation," by H. Schlundt, T. H. Leaming and Julius Underwood; "A New Method for the Study of Silver-Peroxynitrate," by M. J. Brown; "The Vosmear Phenomenon," by W. C. Moore; "The Equilibrium Between Bromine and Potassium Bromide Solutions at Zero Degree," by Grinell Jones and M. L. Hartmann.

A Simple Construction of Small Commutators

An ingenious method of constructing small commutators from round bar material is disclosed in a patent No. 1,195,861, granted to Edward F. Smith of Cincinnati, Ohio. Copper in the shape of a cylindrical block is formed with a central bore, having countersunk recesses in its opposite flat sides and radially arranged



SECTION OF COMMUTATOR BLANK, INSULATING MATERIAL IN PLACE, AND SECTION OF COMPLETED COMMUTATOR

cuts which extend in from the peripheral side toward this bore. These cuts are all of practically equal depth and terminate so as to leave an intact annular zone of metal around said bore so that a blank results as shown. This blank is then placed in a cylinder, and dielectrical material, in plastic condition, is placed upon the blank within the cylinder. By means of a plunger this material is forced against the blank so as to enter all open parts of it, the object being to fill these parts completely. The blanks are then removed from the cylinder, surplus material, especially that which fills bore and recesses, is removed, and the blanks are set aside to permit the material to harden. Next the blanks are rebored to remove the metal within the bore from which action finally a structure results, composed of segments, all insulated from each other by the binding material. A bushing forms a bearing for the commutator.

Cleveland League Opens New Quarters Atop Hotel Statler

On Thursday of this week the 1200 members of the Electrical League of Cleveland celebrated the formal opening of their unique quarters on the roof of the Statler Hotel, fifteen stories above the street. The club rooms consist of a main dining-room, private dining-rooms, a billiard room, a game room, a ladies' parlor, a large main lounging room, foyer, office, and several smaller rooms. The new headquarters will be open from 8.30 a. m. to 11.30 p. m. on week days, and on Sundays and holidays from noon to 9 p. m. Table d'hôte lunches and dinners will be provided by the hotel, and á la carte service is available at all times.

Directors and officers of the organization are: N. H. Boynton, president; J. T. Kermode, vice-president; H. O. Leinard, treasurer; R. S. Dunning, secretary; Norman Anderson, J. M. Bateman, H. J. Davies, Mathias Turner, George S. Milner, H. C. Turnock, M. H. Moffett, F. R. DuGuay, H. L. Schneider, M. G. Buchan, H. S. Greene, and Prof. H. B. Dates.

F. C. Foster of the Buckeye Lamp Division had charge of the opening and R. S. Ingle, former sales manager of the Tregoning Electric Company, is chairman of the house committee.

Two years ago, the Cleveland League boasted of a membership of 400, with a gross revenue of $2,000 per year. To-day the membership totals more than 1200 and the annual revenue has increased to $14,000.

Report of Chicago Gas & Electric Department

The annual report of the department of gas and electricity of the city of Chicago for the year 1915 has just been issued and shows that during the year all inclosed arc lamps, except the sixty-three in Morgan Park, were replaced with 600-cp. incandescent lamps. A number of flame arc lamps were replaced during the year with 600-cp. incandescent lamps in order to provide flame arcs for installation in the Halsted Street district, where their operation, it is stated, will be more economical. Another object, it is stated, was the reduction of the winter load of the Sanitary District. The following table shows the number of electric street lamps in service at the first of the year, at the close of the year, and the average number operated during the year ended Dec. 31, 1915:

LAMPS IN SERVICE

Municipal System	December 31, 1914	1915 Average	December 31, 1915
Flame arcs	9,916	9,882.35	9,436
600 C. P. incandescent	3,500	8,811.21	12,271
100 C. P. incandescent	7,173	7,330.43	7,509
Inclosed carbon arc 7 amp.	6,289	2,228.30	.....
Inclosed carbon arc 6.6 amp.	70	63.15	63
250 C. P. incandescent	92	98.99	100
Rented system:			
Flame arcs*	1,210	1,288.61	1,324
Magnetite arcs	.....	10.72	12
Tungsten—40-watt	47	47.00	47

*Includes 61 multiple arcs.

The total cost of the municipal electric street lighting system for the year was $712,442.07, divided among the different types of lamps as follows: Flame arc, $351,222.90; inclosed arc, $59,406.24; 600-cp. incandescent, $241,389.33; 100-cp. incandescent, $60,723.60. The largest item of expense was for Sanitary District energy, which amounted to $198,744.88. The only other items over $100,000 were carbons and renewals, $126,387.28, and cleaning, trimming and patrolling, $170,314.35. In the following table there is given the detailed costs during 1915, the cost being the average for all lamps:

DETAIL COSTS OF ELECTRIC STREET LAMPS—1915. AVERAGE ALL LAMPS

	Flame Arcs	Inclosed Arcs	600 C. P. Incandescent	100 C. P. Incandescent
Average number of lamps	9,822.4	2,291.5	8,910.2	7,330.4
Sanitary district energy	$9.844	$9.482	$7.569	$1.677
Sub-station operation	1.033	.982	.702	.178
Carbons and renewals	5.721	.769	6.403	1.507
Globes	.923	.301	.338	.551
Repairs to lamps	2.442	1.882	1.086	.015
Trimmings, cleaning and patrolling	8.170	8.792	5.726	2.510
Repairs to circuits, conduits and posts:				
Multi-conductor cable	.092	.034	.039	.016
Lead covered underground cable	1.500	.624	.502	.035
Armored underground cable	.093	.045	.018	1.033
Aerial wires and poles	4.981	2.269	3.963	.017
General expense	.221	.221	.221	.221
Supervision (office expense)	.524	.524	.524	.524
Cost per lamp	$35.544	$25.925	$27.091	$8.284

A valuation of the municipal electric system places the depreciated value at $6,299,767.52, divided as follows: Grounds, $64,096.06; buildings, $239,558.23; steam plant, $45,196.47; electric plant, $475,319.67; lamps, $464,827.68; circuits, $2,997,064.35; conduits, $1,531,000.50, and posts, $482,704.56. Fixed charges for the year, which included ground rent, office rent, taxes, depreciation, interest and other department services, amounted to $782,390.67. The largest item was depreciation, for which $404,900.98 was written off.

Operation of a Small Diesel Engine Plant

Special Construction and Methods Devised to Overcome Operating Difficulties in a 200-Kw. Municipal Lighting Station

IN connection with the operation of Diesel oil engines in the municipal lighting plant of Downers Grove, Ill., several problems have been worked out in an interesting way. The elimination of noise from the engine exhaust by a special muffler, the handling of engine cooling water and the heating of the operating room in winter are features dealt with in what follows.

The equipment installed in the Downers Grove plant consists of two horizontal, two-stroke-cycle Snow crude oil engines, each rated at 120 hp., and direct connected to a 100-kw., 2300-volt, three-phase, 60-cycle generator, which runs at 200 r.p.m. Twenty-four-hour service is maintained, and besides carrying the lighting load the city water is pumped, as far as possible, during the off-peak period. The service has been very dependable, as evidenced by the fact that during 1915 service was interrupted but once, and then for one hour and thirty minutes, due to a cable burnout.

ENGINE EXHAUST MUFFLERS

When the engines were placed in operation the noise of the exhaust and the vibration it caused brought up an operating problem which required considerable study, and was worked out by H. A. Gardner, superintendent of the plant, through the construction of special mufflers. One of the two mufflers used is shown in an accompanying illustration. The location of a deep well between the two units made it impossible to pipe the exhaust to one muffler, so that two were installed at opposite sides of the station. These are constructed of heavily reinforced concrete with a conical shaped roof and steel stack projecting 3 ft. out of the top. They are about 8 ft. in outside diameter and 10 ft. high to the top of the concrete and set on six concrete piles instead of solid foundation to prevent vibration.

The size of the mufflers was determined by the piston displacement and scavenger air volumes per stroke. The exhaust enters at the bottom and on the side, where a circular brick work makes the gases whirl about the center of the muffler. This circular motion has a tendency "to pull a vacuum" behind the gases. On top of the brick work forming the first stage is a system of grate bars, and on top of these are ordinary brick in layers which act as a baffle to gradually release the exhaust gases and reduce the noise. On top of this is a fine wire screen with a layer of crushed stone to further reduce the exhaust report. The conical shaped top is merely to keep the rain out. Connection to the sewer is made to drain the condensation on the interior.

In order to keep the concrete from getting too hot when the engines are running continuously under heavy load, a 0.5-in. pipe is run out and tapped into the exhaust pipe just outside the muffler, and a small amount of water turned on. This water is carried into the muffler as steam, and keeps the temperature down. Frequently, an accumulation of carbon in the muffler will catch fire. This is allowed to burn out for a while, or

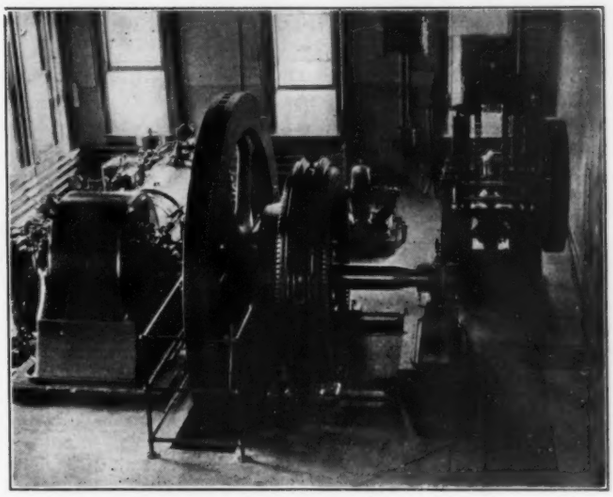


FIG. 1—ONE OF TWO OIL-ENGINE-DRIVEN GENERATORS AND DEEP-WELL PUMP IN DOWNERS GROVE (ILL.) STATION

until the concrete begins to get too hot, and then water is turned on full in the small pipe to put the fire out. This process makes the muffler self-cleaning. The mufflers are so effective that the exhaust cannot be heard or any vibration of the air or ground felt when standing immediately beside them.

ENGINE COOLING WATER

Cooling water for the two engines is taken from a surface water reservoir, a short distance from the powerhouse, as the city water leaves so much scale that it would soon clog up and cause engine heating trouble. Then for reasons of economy a small spray pond was installed and water only lifted from the surface reser-

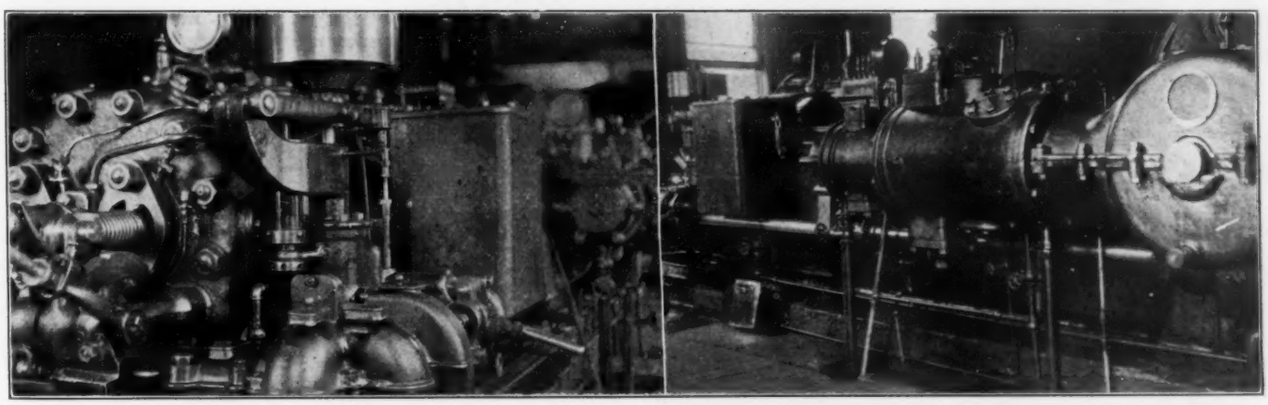


FIG. 2—REAR AND SIDE VIEWS OF OIL ENGINE SHOWING HOLES IN FLOOR THROUGH WHICH INTAKE AIR DRAWN OVER THE EXHAUST PIPE IS TAKEN

voir to make up for the 3 or 4 per cent evaporation loss. Two small 2-hp., three-phase, 1750-r.p.m. centrifugal pumps take care of this circulation of cooling water. One of these takes the cool water from the spray pond, circulates it through the engine and returns it to the hot well. The other pumps out of the hot well and circulates through the spray nozzles. A 5-hp., three-phase, 900-r.p.m. geared three-plunger pump, shown in Fig. 5, with the two small centrifugal units, is used to lift the water from the surface reservoir, and is of sufficient capacity to take care of an additional future engine unit. A city water connection is provided, but is used only in case of emergency.

Engine Intake Heating Problem

When both engines are running, their intake exhausts about 4000 cu. ft. of air a minute from the room. After the installation was made, it was soon found to be practically impossible to keep the engine room warm enough in winter. This was ingeniously overcome by making a special air intake to the room, and at the same time utilizing a portion of the waste heat of the exhaust. The iron exhaust pipe for one engine on the outside of the station was bricked in, as shown in Fig. 3, leaving about a 6-in. space around the pipe and with the outer end of the brickwork open. The inner end of this brickwork opens into the floor of the engine room right at the intake ports of the engine. The air is thus drawn in over the hot exhaust pipe, providing a source of hot air to produce a better mixture in the cylinder, and also overcoming the draught of warm air from the room. The exhaust pipe from the other engine is carried through the oil tank room, and the whole room is used as an intake flue for the engine. Incidentally this heat in the oil tank room keeps the oil in good condition in the coldest weather.

The village water is supplied from two deep wells, and in order that the pumping could be done entirely by electrical means a special type of deep-well pump manufactured by the Deming Company was installed. These two deep-well pumps are belt driven by 15-hp., 220-volt, three-phase, variable speed motors, and a 36-in. stroke obtained by a crosshead supported between two chains, which travels around with the chain. These were the first pumps of the kind to be installed, and their operation is considered very satisfactory. During peak load the deep-well pumps are slowed down to the bare requirements of the system. They discharge into a 60,000-gal. cistern, from which the water is supplied under 60-lb. pressure to the mains and standpipe by two centrifugal, two-stage, 350-gal.-per-minute pumps, driven at 1750 r.p.m. by 20-hp., variable speed, 220-volt, three-phase motors, which are also slowed down during peak load periods.

The energy for pumping is paid for at a certain rate per kilowatt-hour, which includes the labor of caring for the pumps, as this can be handled by the station operators with no additional labor charge. The total station labor is handled in three ten-hour shifts of one man each, two of the shifts overlapping in the afternoon, so that two men are available for repair work.

Operating Costs

Oil is purchased in 10,000-gal. lots from the Texas company and stored in a 12,000-gal. tank at the station. The average fuel cost for the year 1915 placed in the tank at Downers Grove was $0.0294 per gallon. The average cost of oil at the switchboard for the same period, including that used in trial runs, testing out, tuning up, etc., was $0.00331 per kilowatt-hour. The oil consumption was found on test to be as follows:

0.50 lb. oil per brake horsepower hour, full load.
0.52 lb. oil per brake horsepower hour, three-quarters load.
0.60 lb. oil per brake horsepower hour, one-half load.

The oil used has a heat value of 19,000 B.t.u. per pound. The over-all efficiency of the station is over 30 per cent.

FIG. 3—REINFORCED CONCRETE MUFFLER AND EXHAUST PIPE BRICKED IN FOR SPECIAL AIR INTAKE TO ENGINE

FIG. 4—SMALL SPRAY POND FOR OIL ENGINE COOLING WATER

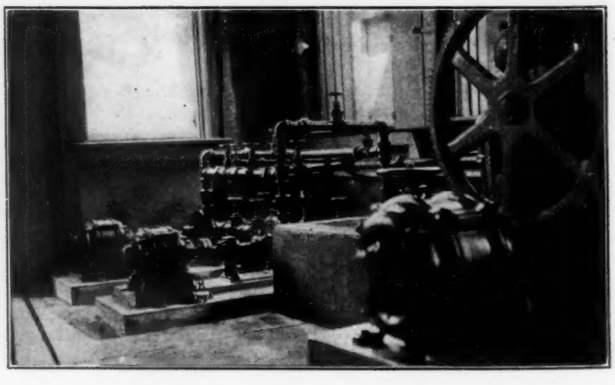


FIG. 5—TWO CENTRIFUGAL PUMPS AND GEARED THREE-PLUNGER PUMP ON ENGINE COOLING WATER SYSTEM

Eliminating Transmission Line Telephone Troubles

Methods and Arrangements Employed by the Georgia Railway & Power Company for Protecting Telephones and Operators When Using Instruments on Circuits Carried on Transmission Line Structures

BY E. P. PECK

Superintendent Department Tests and Repairs, Georgia Railway & Power Company

WHEN telephone lines parallel high voltage power lines and are carried on the same supporting structures, unreliable service, constantly recurring troubles and danger in operation are factors that must be dealt with. Reliable communication between power houses and sub-stations is always essential and in order to be sure of this service at all times, provisions in design and installation must be made such that telephone apparatus will not be damaged at the time of line or equipment disturbances.

The first requirement for high voltage telephone lines is high insulation. It has been found necessary to insulate the telephone lines of the Georgia Railway & Power Company paralleling 110,000 volt transmission circuits from Atlanta to Tallulah, Ga., with two suspension insulators in series, which provide sufficient insulation for a working voltage of 22,000. This high insulation is necessary to prevent puncture to the insulators at times of lightning storms or transmission line disturbances. It is also necessary to prevent leakage over the insulators which would cause the line to become unbalanced and noisy.

The second requirement is very carefully balanced transportations. This is necessary to prevent an induced voltage between the two telephone lines. The power line will necessarily induce a high voltage from the telephone lines to ground, but the voltage between telephone lines must be maintained at a low value.

The third requirement for good telephone line operation is an adequate drainage system. On telephone lines, which closely parallel for a long distance high voltage power lines, a voltage from the telephone line to ground of several thousand volts will be induced. If the telephone line is grounded, a current of several amperes will flow through the ground connection. Drainage coils to be effective, therefore, must be of sufficient capacity to carry the line charge to ground continuously. On the 110,000-volt telephone lines of the Georgia Railway & Power Company 15 kw., 2200-volt standard distribution transformers are used as drainage coils. The 2200-volt leads are connected to the telephone lines and the middle point of the 2200-volt winding is grounded. The secondary leads are, of course, open. These drainage coils are protected by cylinder gaps set 0.2 in. from each line to ground and by 25 amp. high voltage expulsion fuses on the line side of the ground gaps. The drainage coils and their protective equipment are installed outside of the building. We have had a few disturbances which have blown drainage coil fuses violently, but no damage has resulted to drainage coils.

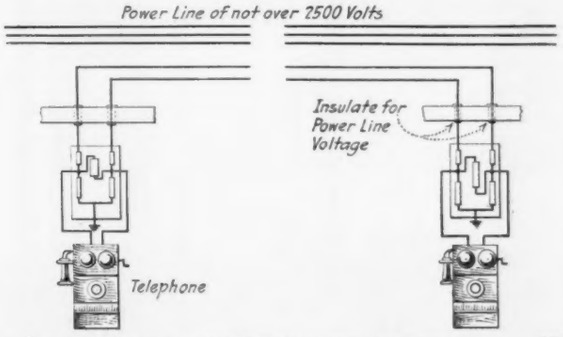


FIG. 1—TELEPHONE CONNECTIONS FOR CIRCUITS NEAR 2500-VOLT TRANSMISSION LINE

The fourth requirement is lightning protection of the best possible character for the telephone terminal apparatus. The writer has made an exhaustive study of the problems involved in this connection and has finally developed a type of lightning arrester which in its several forms has during the past two years rendered practically complete protection to telephone instruments and operators under all conditions. This development has been along the lines explained by the writer at the 1915 convention of the American Institute of Electrical Engineers in Detroit, Mich.

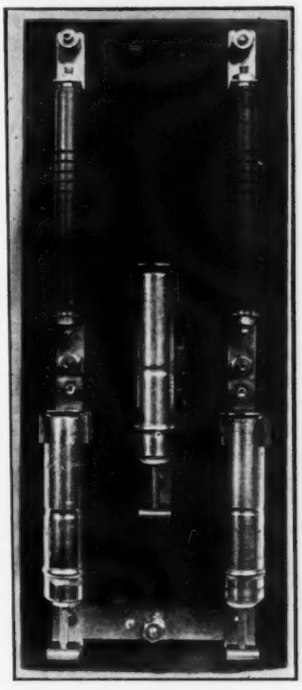


FIG. 2—TELEPHONE ARRESTER FOR USE NEAR 2500-VOLT POWER LINES

Since high voltage telephone line installation has not been standardized, it was necessary to adopt standards of our own. The different sizes of lightning arresters were so made and insulated that if full transmission line voltage be impressed on them from either the line to line connection or a line to ground connection, no damage could be done to the telephone arrester or the telephone equipment. This is a severe requirement, but the position was taken that a mistake in insulating the telephone line for too low voltage does not justify under-insulation on the telephone lightning arrester. The point has been brought up that it is unnecessary to insulate the telephone arresters for a higher flashover voltage than is provided for on the telephone line insulators. The writer believes, however, that the arrester should be safe and should function properly regardless of the performance of the rest of the line. This requires that auxiliary protection be put outside the building entrance and that all telephone lines from this entrance to the top of the arrester be insulated for the full voltage which the auxiliary gaps may allow to pass.

CONSTRUCTION OF ARRESTERS

Three sizes of telephone arresters have been designed and for convenience are designated as *P-A*, *P-B* and *P-C*. The essential features of these designs are shown in the accompanying illustrations and diagrams. The *P-A* construction is for use in ordinary telephone lines where good protection is required. By ordinary lines is meant lines which are not subject to crosses with lines

having voltages higher than 2500. The *P-B* arrester is designed for use on telephone lines which are liable to be crossed with power lines having voltages up to 35,000 volts. The *P-C* arrester is designed for use on telephone lines which may be crossed with lines of any voltage higher than 35,000, the limit of the arrester being the limit of the transmission voltage; that is, the arrester is designed and will properly function on 100,000 and 150,000-volt lines. Any of the arresters will give good protection to the telephone in cases of ordinary lightning trouble.

The *P-A* arrester consists of vacuum gaps connected as shown in Figs. 1 and 2, with fuses between the vacuum gaps and the incoming telephone lines. These fuses should not have a rating of over 7 amp. or less than 5 amp. This arrester was designed primarily for junctions of overhead lines with telephone cables. In this case it is necessary to hold the voltage from line to ground low as well as to hold the voltage from line to line low. Where a telephone cable is not connected but protection is desired for an instrument at the terminus of the overhead line, a slightly modified form of the *P-A* arrester is satisfactory. This arrester differs in the respect that it has air spark gaps from each line to ground instead of vacuum gaps. These air gaps will not hold the voltage from line to ground at as low a value as will the vacuum gaps, but will hold it sufficiently low to give satisfactory protection to a telephone instrument under the conditions mentioned here.

The *P-B* arrester shown in Figs. 3 and 5 is designed for very much higher voltage lines and for this reason is larger and has the ground gaps adjustable. This adjustment is provided so that for any line the ground gaps can be set for the conditions of that line, in every case being set low enough so that the arrester will discharge in case of any disturbance, but will not be subject to continuous discharges in regular operation.

GROUND GAPS AND LINE-TO-LINE GAPS

Any telephone line paralleling a high voltage power line will have a voltage induced between the telephone

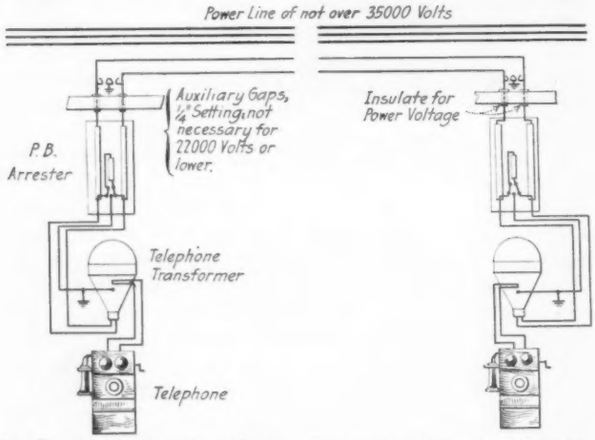

Power Line of not over 35000 Volts
Auxiliary Gaps, 1/4" Setting, not necessary for 22000 Volts or lower.
Insulate for Power Voltage
P.B. Arrester
Telephone Transformer
Telephone

FIG. 3—TELEPHONE CONNECTIONS FOR CIRCUITS NEAR POWER LINES UP TO 35,000 VOLTS

line and ground. The ground gaps should therefore be adjusted in proportion to this voltage. The probable setting of these ground gaps should be between 1/64 and 1/16 in. The protection to the telephone instrument is provided by a vacuum gap connected from line to line. This vacuum gap is paralleled by a very small air gap which comes into play only in case the vacuum gap has been destroyed by a small but continuous discharge. If it is found at any time that the compound has melted from the bottom of the vacuum gap, this unit must be replaced, as the vacuum is destroyed when the compound is melted, and the discharge voltage of the gap changes from approximately 350 to several hundred volts higher. The writer has found that vacuum gaps are damaged very seldom, but it was thought advisable to provide the auxiliary gaps as an added protection, as the vacuum gaps will sometimes go down. The air gap from line to line is set 0.004 in. and should not be changed.

In the *P-B* arrester all of the protective gaps are

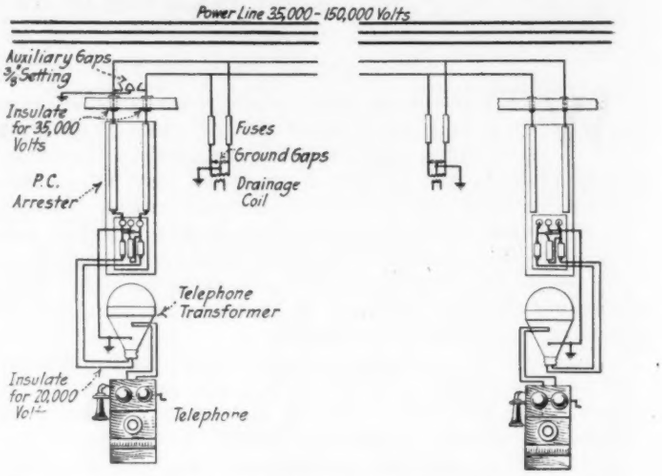


FIG. 4—TELEPHONE CONNECTIONS FOR CIRCUITS NEAR VERY HIGH VOLTAGE LINES

themselves protected by 12-in. expulsion fuses connected between these gaps and the line. These fuses should have a capacity of between 5 and 7 amp. The fuses and gaps are mounted on a hinged base so that the working parts of the arrester can be disconnected from the line when it is necessary to replace the fuses or to adjust the gaps. It is recommended that this switch be pulled when it is necessary to work on the arrester.

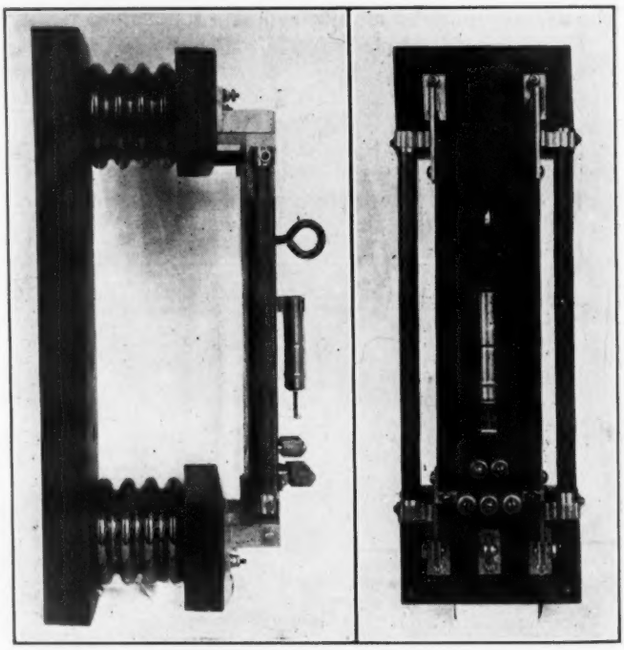


FIG. 5—TELEPHONE ARRESTER FOR USE NEAR POWER LINES OF VOLTAGES UP TO 35,000

The insulation between the various parts of the arrester is sufficient to stand a continuous application of 25,000 volts and for lines up to this voltage no auxiliary gaps are necessary. When the arrester is used on lines having voltage higher than this, that is, between 25,000 and 35,000 volts, auxiliary horns are necessary and should be placed outside the building and connected from

line to ground. The setting of these auxiliary horn gaps should be 0.25 in.

The wiring from the building entrance to the top of the arrester should be insulated so that a flashover cannot occur from line to line or from line to ground in case of a cross between the telephone line and the power line. That is, in case the telephone line parallels a 25,000-volt power line, the wiring from the cut-in to the arrester should be safe for 25,000 volts when applied from line to line or from line to ground.

A telephone transformer, which is insulated for 25,000 volts from primary to secondary, should be used between the telephone instrument and the incoming line on all telephone lines which are subject to crosses with power lines of 6,600 volts or over. It is not recommended that any high voltage line be operated without this transformer in service, on account of the danger to the person using the telephone. Such telephone lines are liable to become exceedingly dangerous at any time and the protection of this transformer is desirable at all times. The *P-B* arrester should be placed between the telephone transformer and the incoming line to prevent damage to the transformer windings due to excessive voltage from line to line.

FEATURES OF HIGH VOLTAGE ARRESTER

The *P-C* arrester shown in Figs. 4, 6 and 7 is designed to protect telephone lines which parallel power lines of 35,000 volts or higher. That is, the arrester must afford protection to the station telephone apparatus if the telephone line becomes crossed with a power line operating at 110,000 volts, or at a higher voltage. This arrester is similar in principle to the *P-B* design, but has higher insulation and larger fuses. Also choke coils are provided on the telephone side of the discharge gaps. The construction is larger and much more rugged on account of the more severe conditions which are

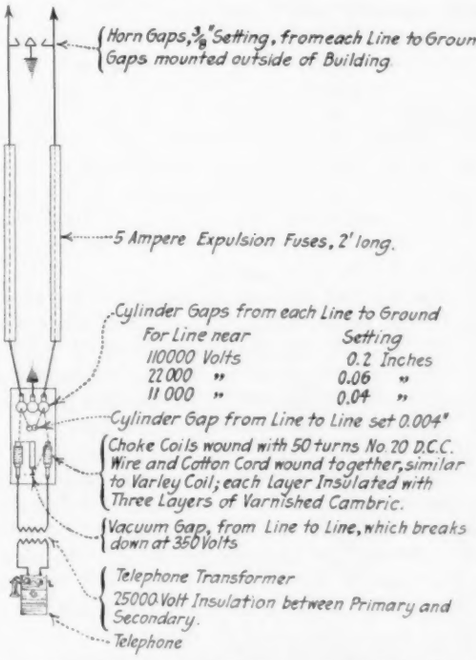

Horn Gaps, 3/8" Setting, from each Line to Ground. Gaps mounted outside of Building
5 Ampere Expulsion Fuses, 2' long.
Cylinder Gaps from each Line to Ground
For Line near Setting
110000 Volts 0.2 Inches
22000 " 0.06 "
11000 " 0.04 "
Cylinder Gap from Line to Line set 0.004"
Choke Coils wound with 50 turns No. 20 D.C.C. Wire and Cotton Cord wound together, similar to Varley Coil; each Layer Insulated with Three Layers of Varnished Cambric.
Vacuum Gap, from Line to Line, which breaks down at 350 Volts
Telephone Transformer
25000 Volt Insulation between Primary and Secondary.
Telephone

FIG. 6—CONSTRUCTION OF TELEPHONE ARRESTER FOR USE NEAR VERY HIGH VOLTAGE POWER LINES

likely to be imposed on the arrester. The fuses are mounted on a hinged frame and are of the expulsion type, 24 in. long. The size of the fuse wire required is 7 or 5 amp. The ground gaps on this arrester are adjustable and should be set so that they do not discharge except in case of disturbance on the line. The setting of the gap will vary from 1/16 to ¼ in., depending on the voltage from the telephone line to ground. The setting of the ground gap does not determine the protection afforded the telephone instrument. These ground gaps must be set low enough to protect the high voltage winding of the telephone transformer. It is really not of great importance that these gaps be set low, but it is important that both ground gaps be set the same. The protection to the telephone instrument is given by the vacuum gap and the 0.004 in. air gap, both of which are connected from line to line.

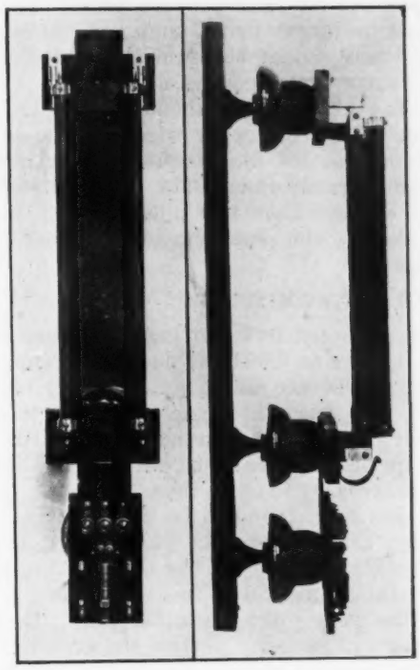


FIG. 7—TELEPHONE ARRESTER FOR USE IN NEIGHBORHOOD OF VERY HIGH VOLTAGES

It is essential that this arrester be itself protected by auxiliary ground gaps placed just outside of the building cut-in, and these gaps should be set at approximately ⅜ in. The gaps will afford protection to the inside wiring up to the arrester and to the top of the arrester itself in case of a cross between the telephone line and the power line. The wiring from the building entrance to the top of the arrester should be mounted on insulators which will not flashover at less than 45,000 volts. The wiring from the bottom of the arrester to the telephone transformer should be safe for 20,000 volts. From the telephone transformer to the telephone instrument ordinary telephone wire may be used. The frame of the telephone transformer should be solidly grounded in all cases.

The setting of the line to ground gaps for the *P-B* arresters are made 1/32 in., when the arresters are used on 11,000 and 22,000-volt lines. The setting of the line to ground gaps on the *P-C* arrester is 0.2 in. when used on 110,000-volt lines. The settings of the line to line gaps on all of the arresters of this line are 0.004 in. The discharge voltage of the gaps at these settings is approximately 700 volts for the 0.004 in., 3000 volts for the 1/32 in. and 10,000 volts for the 0.2 in. The vacuum gaps discharge at approximately 350 volts.

INSTALLATION AND INSPECTION OF ARRESTERS

The main points to be noted in installation and inspection are as follows: *Horn Gaps:* The horn gaps outside the building should be of heavy material, that is, not smaller than 0.25 in., and these horns should be so located that a continuous heavy arc on them will do no damage. The settings should be correct.

High Voltage Wiring: The telephone wiring from the horn gaps to the telephone arrester should be as recommended for each arrester.

Telephone Arrester: The arrester should be mounted in a clean dry place and should be located so that the violent blowing of the expulsion fuses cannot damage anything. The setting of all gaps should be checked and the condition of the vacuum gaps noted. If the vacuum gap has been damaged from heat, the sealing compound

will have been melted and will have run over the small porcelain insulator in the bottom of the gap and perhaps down the stem. This is the first indication of trouble on the vacuum gaps. The condition of all air gaps should be noted, paying special attention to any burning of these gaps or any dirt between them. The fuse wire should not be larger than 7 amp., or smaller than 5 amp. The bases should be examined to see if they have become charred by excessive discharges.

Ground Wire: The ground wire should not be less than No. 8, preferably No. 6, copper wire and should connect to the ground post of the arrester and to the frame of the telephone transformer. The ground itself should be made of not less than two pipes 0.75 in. in diameter and 6 ft. long. The pipes should be spaced 6 ft. apart if practicable.

Operating Results

Trouble has been predicted from setting the cylinder gaps between lines as low as 0.004 in., due to the gaps burning together during severe discharges. The writer has found, however, that when these gaps are protected by 5 amp. fuses they do not burn together. Very little trouble has been experienced from dust settling in the gaps, although it is necessary to clean them at times.

The 5 amp. fuse has been found to be very satisfactory. It is so large that it does not blow except in cases of extreme trouble; on most of the Georgia Railway & Power Company's lines these fuses blow only a few times during the year. On the other hand, the fuses are small enough to properly protect the arrester even if blown several hundred times. Some of the first arresters gave trouble due to leakage across the surface if exposed to dust and moisture for a long time. This trouble has been slight, however. Another trouble has been that a very slight continuous discharge through the vacuum gap will in time burn out the vacuum gap, allowing the voltage across the telephone terminals to rise to the discharge value of the auxiliary gap, which is approximately 700 volts. Following this the telephone bell magnets, induction coils and hook switches have been damaged. Two years of service with fifty or more of these arresters installed on high voltage lines has shown that this trouble is far from serious, since not more than ten or twelve vacuum gaps have been destroyed each year. On the other hand not a single telephone transformer has burned out, a single operator been hurt, or any extensive damage done to the telephone instruments, although the telephones have been used at the time of direct strokes of lightning and in two cases when a 22,000-volt line fell on the telephone line.

The tests made by the writer on the arrester have included the impressing of full 110,000 volts from the power line. This test did not damage the arrester or the telephone instrument and shows that the protection would be complete in case of a cross between the telephone line and the 110,000-volt line. Previous to the installation of these arresters, damage amounting to more than $1,000 was done to telephones and instruments in one year of service. With the complete telephone equipment installed as outlined on the system of the Georgia Railway & Power Company it has been found perfectly safe to continue the high voltage telephone communication through underground cables to an office telephone or to a telephone switchboard. The load dispatcher, through his telephone board, can communicate directly with all of the water-power stations and substations, although he is located in Atlanta and his board is connected to the high voltage lines through approximately three miles of standard underground telephone cable. No trouble on this cable of any kind has been experienced due to high voltage since the installation of the protection.

PERFORMANCE OF BOILERS OPERATING AT OVER RATING

Results of Tests for Twenty-two Installations Using Different Grades of Coal with Underfeed Stokers Under Different Operating Conditions

The data presented in the accompanying table shows the test performance of various types of boilers operated by twenty-two different companies and equipped with Taylor underfeed stokers burning different grades of fuel. The range of boiler rating is from 130 hp. to 2365 hp. Since the conditions under which the tests were made were different in many respects, the data does not indicate the superiority of one boiler over another, but merely affords an opportunity of studying what results could be obtained under similar conditions. It also serves to indicate that 10 sq. ft. of heating surface is no longer required to develop a boiler horsepower even when retaining the same definition of boiler horsepower that has been in existence for a long time. Inspection of the data will reveal the fact that equivalent evaporations as high as 9.26 lb. per square foot of heating surface have been obtained, and rates of 6, 7 and 8 are not unusual. While the higher rates, in general, have been attended by decreased efficiency, the combined furnace and boiler efficiency did not drop much below 70 per cent even for the highest evaporative rate. It may be pointed out that the manufacturers' ratings were exceeded in practically every case.

The data show no indications of any attempts to reduce flue-gas temperature, most of the readings being between 500 and 600 deg. Fahr. In a few instances the temperatures were less than 500 deg., but usually these occurred when the evaporation rates were low or when air leaks existed in the breeching. In most of the tests, the draft over the fire was kept very low, usually much less than 1/10 in., the necessary difference in pressure between the upper and lower surfaces of the fuel bed being maintained by relatively high pressures in the tuyere box. In general, the tuyere-box pressures were about 3 in. Some relatively high fuel consumptions per square foot of grate surface were obtained, the highest rate being 78 lb., occurring with an evaporation of 8.68 lb. The highest evaporation per pound of coal fired was 10.68 lb., this performance being obtained at two evaporation rates—6.15 lb. and 3.59 lb.

While the figures indicating the percentage of combustible in the refuse may appear high, it can be seen by multiplying them by the percentage of refuse from combustion that the maximum amount passing into the ash pit is only about 6 per cent of the total amount of coal fired, with the average much less. Although it would be expected that the percentage would have a tendency to increase when the evaporation rate was greatly increased, due to incomplete combustion, the performance data do not, in general, show any such tendency. According to tests at one of the New York Edison Company's stations, 9.4 to 12.3 per cent of the heat available from coal is lost through flue gases, 0.7 to 3 per cent is wasted by incomplete combustion, 6.8 to 15.1 per cent by radiation, and only 0.2 to 0.3 per cent by evaporation of moisture in coal. In one of the Detroit Edison Company's stations, on the other hand, the radiation is only 2.43 to 3.54 per cent, while the other losses are about the same as in New York, 10 to 13.48 per cent escaping through flue gases, and 1.8 to 3.58 per cent being lost by incomplete combustion. In the Chicago and Detroit plants the average equivalent steam consumption required to operate the stokers and blowers was about 3 per cent.

Results of Fifty-one Boiler and Underfeed Stoker Tests Conducted Under Different Conditions

NAME OF COMPANY	Horsepower and Type of Boiler	Number of Retorts in Stoker	Water Heating Surface, Square Feet	Grate Surface Square Feet	Ratio of Grate to Water-Heating Surface	Steam Pressure (Pounds Gage)	Average Steam Temperature (Deg. Fahr.)	Draft Over Fire, Inches	Pressure in Tuyere Box, Inches	Flue Gas Temperature (Avg. Deg. Fahr.)	Feed Water Temperature (Avg. Deg. Fahr.)	KIND AND SIZE OF FUEL: Name and Size	KIND AND SIZE OF FUEL: Volatile Matter, Per Cent	KIND AND SIZE OF FUEL: Fixed Carbon, Per Cent	KIND AND SIZE OF FUEL: B. T. U.	COAL BURNED: Per Hour as Fired	COAL BURNED: Per Hour per Square Feet Grate Surface as Fired	Refuse from Combustion (Percentage of Coal Fired)	Combustible in Refuse, per Cent	Water Evaporated per Hour (Actual)	Factor of Evaporation	Test Rating of Boiler Per Cent Normal	Water Evaporated per Pound Coal as Fired, Pounds	Equivalent Evaporation per Square Foot Heating Surface	Combined Furnace and Boiler Efficiency (per Cent)
Interborough Rapid Transit Company, New York City	520 B&W	7	5,200	94.5	1/55	176.9	378.3	0.09	3.19	539.7	137.4	Berwind & White Somerset Mixed crushed R. O. M.	16.89	71.48	13,775	4,820	51	16	26.19	42,852	1.125	268	8.84	9.26	70.2
Interborough Rapid Transit Company, New York City	520 B&W	7	5,200	94.5	1/55	174.5	377.4	0.05	1.87	464.9	135	Berwind & White Somerset Mixed crushed R. O. M.	17.04	73.40	14,101	2,297	24.3	11.1	20.66	23,190	1.128	143	10.10	4.94	78.2
Iowa Ry. & Light Co., Cedar Rapids	627 Edge Moor	7	6,270	94.5	1/66.4	184.0	523	0.0147	3.17	464	84	Iowa Lakonta slack	26.2	36.8	9,130	4,875	51.5	....	...	28,750	1.263	168	5.88	5.80	79.3
Iowa Ry. & Light Co., Cedar Rapids	627 Edge Moor	7	6,270	94.5	1/66.4	184	505	0.0065	2.13	447	82.2	Springfield, Ill., slack	27.2	47.06	9,302	3,850	35.4	....	...	25,840	1.256	150.1	6.72	5.18	79.0
Iowa Ry. & Light Co., Cedar Rapids	627 Edge Moor	7	6,270	94.5	1/66.4	198	526	0.05	4.1	540	63	Springfield, Ill., slack	26.0	45.6	9,840	7,400	78.5	....	...	42,700	1.272	252	5.76	8.68	72.5
Iowa Ry. & Light Co., Cedar Rapids	627 Edge Moor	7	6,270	94.5	1/66.4	198	544	0.0886	3.51	528	70.3	Springfield, Ill., slack	26.0	45.5	9,840	6,212.5	65.8	....	...	35,100	1.288	209	5.65	7.20	71.7
Boston Elevated Railway Company	600 B&W	7	6,000	94.5	1/63.5	206.6	536.06	....	3.25	527.4	95		19.41	69.21	13,860	5,037.5	53.2	....	...	41,022.7	1.257	249	8.14	8.59	71.62
Boston Elevated Railway Company	600 B&W	7	6,000	94.5	1/63.5	202.84	510.23	0.025	2.23	448.75	153.4		20.21	68.38	13,850	3,268.9	34.6	....	...	30,552.7	1.184	175.1	9.34	6.03	77.7
Boston Elevated Railway Company	600 B&W	7	6,030	94.5	1/63.5	202.26	487.04	0.042	1.25	428.96	140.19		19.35	69.13	13,860	2,405.4	25.5	....	...	22,804.5	1.185	130.5	9.48	4.5	78.62
Boston Elevated Railway Company	600 B&W	7	6,000	94.5	1/63.5	205.06	521.05	0.406	3.5	498.2	84.1		....	....	13,419	5,030	52.3	....	...	40,061.12	1.262	244.0	7.96	8.4	72.6
Long Island City	524.5	7	5,245	94.5	1/55.5	188.7	506.3	0.037	2.10	529.3	55.8	Sonman Wilmore Pa. R. O. M.	20.73	69.03	14,150	2,762.6	29.2	11.3	28.4	23,960	1.289	170	8.67	5.9	76.6
Long Island City	524.5	7	5,245	94.5	1/55.5	190.3	543.4	0.136	3.03	600.7	55.1	Sonman Wilmore Pa. R. O. M.	19.97	67.73	13,738	4,075	43.1	10.1	13.1	32,198	1.304	232	7.9	8	72.8
Pressed Steel Company, McKees Rock, Pa	250 B&W	3	2,500	40.5	1/61.8	134.6	....	0.035	2.82	493.4	104.5	Pittsburgh slack	32.88	51.80	12,668	1,342	33.2	....	41.10	11,294	1.147	150	8.42	5.2	76.3
Pressed Steel Company, McKees Rock, Pa	250 B&W	3	2,500	40.5	1/61.8	133	....	0.08	3.9	728	111		34.8	54.35	12,042	2,178	53.7	....	...	16,825	1.15	224	7.72	7.74	71.2
Parker Webb & Company, Detroit	309 Wickes	3	3,090	40.5	1/76	137	....	0.045	2.8	675.8	184.7		....	....	12,582	2,625	65	....	...	21,765	1.0725	219	8.29	7.55	68.2
Parker Webb & Company, Detroit	309 Wickes	3	3,090	40.5	1/76	140.2	....	0.08	0.87	522	192		....	....	13,547	2,150	26.6	....	...	22,126.8	1.0657	110.5	10.29	3.82	78.2
National Tube Company, McKeesport, Pa	520 B&W	6	5,202	63	1/81.4	161	....	0.05	2.25	447.6	157	Monongahela Crushed Run of Mine	33.4	55.7	13,822	2,563	39.7	....	...	25,633	1.1089	158.5	10.0	5.47	77.93
National Tube Company, McKeesport, Pa	520 B&W	6	5,202	63	1/81.4	158	....	0.09	3.41	472	153	Monongahela Crushed Run of Mine	31.7	56.5	13,587	3,853	61.2	....	...	35,645	1.107	219	9.26	7.53	72.75
Detroit Edison Company	2365 B&W	Two-13	23,654	405	1/58.5	195	518	0.2	0.67	487	187		34.07	59.62	14,188	6,796	16.7	9.7	27.2	65,663	1.1545	92.9	9.87	3.22	77.9
	2365 B&W	Two-13	23,654	405	1/58.5	210	549	0.84	2.53	651	183		33.48	60.58	14,061	16,000	39.5	9.35	36.1	147,435	1.1697	211.3	9.4	7.29	75.84
	2365 B&W	Two-13	23,654	405	1/58.5	206	551	0.84	1.56	647	177		33.21	61.53	14,272	13,730	33.9	8.53	28.8	128,105	1.1822	185.2	9.52	6.40	76.42
	2365 B&W	Two-13	23,654	405	1/58.5	203	532	0.45	....	545	184		32.92	60.44	13,983	10,421	25.7	7.07	29.9	98,073	1.1648	140.0	9.6	4.83	77.66
	2365 B&W	Two-13	23,654	405	1/58.5	200	513	0.2	0.76	493	181		32.46	61.63	13,965	7,770	19.1	6.2	27.1	76,052	1.1579	107.9	9.9	3.72	80.28
Louisville Cement Co., Speeds, Ind.	300 B&W	4	3,000	54	1/55.5	141.5	....	0.12	2.05	....	180.5	Jellico Bituminous Eastern Kentucky 60% slack, 40% nut	32.8	52.75	12,160	2,180	40.5	13.38	26.6	19,500	1.06	200	8.95	6.92	75.6
Cleveland Municipal Plant	1013 Sterling Class W	Two-6	10,130	162	1/62.5	225.5	529.3	0.06	1.28	510.7	71.26	Pittsburgh No. 8 slack	31.82	53.94	12,977	3,433	21	13.7	17.28	29,159	1.2769	106.53	8.49	3.68	81.08
Cleveland Municipal Plant	1013 Sterling Class W	Two-6	10,130	162	1/62.5	237.48	586.40	0.09	3.39	731.87	69.10	Pittsburgh No. 8 slack	31.45	53.31	12,827	7,238	44.6	18.2	33.44	52,866	1.308	197.86	7.30	6.83	72.3
J. R. Foster & Sons, Philadelphia	391 Badenhausen	4	3,910	54	1/72.5	96.8	343	0.0291	2.32	429	76	Clearfield Co. Pa. R. O. M.	20.87	67.87	13,988	1,850	34.2	9.97	30	17,794	1.1835	156	9.62	5.38	78.95
J. R. Foster & Sons, Philadelphia	391 Badenhausen	4	3,910	54	1/72.5	92.47	....	....	2.8	448	105.9	Clearfield Co. Pa. R. O. M.	....	....	14,174	2,300	42.6	....	...	22,750	1.1518	194	9.89	6.7	77.98
American Brass Company, Waterbury, Conn	1500 Bigelow Hornsby	5	5,000	52.5	1/95	127	408	0.12	3.025	507.7	197	New River	23.55	69.09	14,421	5,490	34.8	10.25	18.5	57,900	1.09	122	10.55	4.2	77.3
American Brass Company, Waterbury, Conn	1500 Bigelow Hornsby	5	5,000	52.5	1/95	126	425	0.30	3.7	526	213	Elizabeth	69.08	21.78	14,349	5,990	35.7	10.12	...	61,000	1.078	191	10.2	6.59	74.3
Old Colony Street Railway Company, Quincy Pt., Mass	687.5 B&W	8	6,875	102	1/67.4	173	511	0.35	2.8	599	131	George's Creek	....	....	....	3,970	38.9	....	...	36,400	1.203	190	9.15	6.56	74.4
New York Edison Company	650 B&W	7	6,500	105	1/61.8	193.4	454	0.39	1.9	455	154		19.4	71.4	14,516**	2,300	21.7	7.3	12.8	22,780	1.154	125.8	9.9	4.12	78.5
	650 B&W	7	6,500	105	1/61.8	193.7	461.5	0.38	2.1	468	161.2		18.8	71.6	14,291**	2,500	23.6	8.7	14.9	25,040	1.151	157.2	10.0	4.52	79.8
	650 B&W	7	6,500	105	1/61.8	194.1	451.8	0.37	2.2	475	172.8		19.9	71.1	14,702**	2,825	26.7	7.3	17.7	28,080	1.135	168.3	9.93	4.99	76.5
	650 B&W	7	6,500	105	1/61.8	193.2	466.7	0.35	2.9	519	172		19.9	70.7	14,858**	3,843	36.2	8.4	26.1	36,360	1.143	191.7	9.5	6.51	72.7
Narragansett Electric Lighting Co., Providence, R. I	440	.....	....	...	....	172.73	....	0.085	...	544.2	195.2	New River	11.00	80.01	14,501	2,370	30.3	6.5	...	25,365	1.07	180.4	10.68	6.15	76.04
Fort Worth (Tex.) Power Company	600 Edge Moor	7	6,000	94.5	1/63.5	207	517	0.07	1.60	390*	191.7	Texas Brown Lignite Crushed R.O.M.	29.57	27.88	7,037	6,051.3	64	....	36.76	24,887	1.149	138.7	4.11	4.77	65.0
Fort Worth (Tex.) Power Company	600 Edge Moor	7	6,000	94.5	1/63.5	206.4	510	0.09	2.00	390*	186.5	Craig R. O. M. Crushed to Nut and Slack	34.72	52.6	12,751	3,510	37.1	14.2	12.72	31,773	1.149	176	9.05	6.1	79.1
Fort Worth (Tex.) Power Company	600 Edge Moor	7	6,000	94.5	1/63.5	206.5	505	0.26	3.62	362.*	192.3	Ark. semi-anthracite, very fine slack	...	...	10,275	3,850	40.8	....	...	26,724	1.142	148.5	6.99	5.12	75.5
National Tube Co., Kewanee, Ill.	613 Edge Moor	7	6,132	91	1/67.4	122.9	457.06	0.056	3.31	510.3	184	Illinois Bituminous Screenings	...	...	9,976	6,118	67.2	16.5	10.98	38,359	1.1318	205.2	6.27	5.92	69.92
National Tube Co., Kewanee, Ill.	613 Edge Moor	7	6,132	91	1/67.4	117.6	426.6	0.011	1.95	412	194.9	Springfield, Ill., slack	...	...	9,302	3,093	34.0	17.6	6.73	21,721	1.1049	113.4	7.022	3.28	80.95
Commonwealth Edison Co., Chicago	.....	.....	....	...	....	163.6	....	0.16	3.10	553	52.5	Duff No. 5	....	....	9,468	4,126	57.3	12.3	22.5	24,144.1	1.217	167.2	5.85	5.74	72.4
Milwaukee Electric Ry. & Lt. Co.	250 Return Tubular	.....	....	...	....	176.9	505.2	0.167	2.53	499.3	112.1		32.77	52.9	12,538**	4,380	.....	14.33	...	34,000	1.2274	158.6	7.77	....	78.2
Penobscot Chemical Fibre, Great Works, Me	600 Dillon H. R. T.	3	7,200	81	1/89	81	....	0.06	1.6	595	145	New River R. O. M.	20.05	67.23	13,541	2,766	34.1	....	...	27,334	1.105	146	9.882	4.2	78.25
Penobscot Chemical Fibre, Great Works, Me	600 Dillon H. R. T.	3	7,200	81	1/89	85	....	0.05	2.6	....	145	New River R. O. M.	20.05	67.23	13,541	3,750	43.05	....	...	35,721	1.106	191	9.53	5.5	75.5
Everett Mills, Lawrence, Mass.	130 Manning	.....	1,300	23	1/11.2	117.1	388.6	0.187	1.42	600	142.54	Pocahontas Semi-Bituminous R. O. M.	19.89	73.12	14,490**	1,360	29.6	6.26	...	6,708	1.14	147.4	9.86	4.89	76.38
	.....	.....	....	...	....	130.2	408.9	0.187	1.41	598	144.15		19.89	73.12	14,490**	656	32.6	6.4	...	6,814	1.148	150.8	9.10	5.01	71.03
	.....	.....	....	...	....	123.65	397.3	0.187	1.49	599	142.35		19.89	73.12	14,490**	649	32.3	6.72	...	6,855	1.144	151.4	9.24	5.02	71.85
	.....	.....	....	...	....	125.24	402.1	0.187	1.41	599	143.114		19.89	73.12	14,490**	582	31.9	6.32	...	6,780	1.146	150.1	9.26	4.97	72.12
Public Lighting Plant, Detroit	400	.....	4,013	43.5	1/92.3	162.44	371.3	0.22	1.24	516	158	Meadow Creek, W. Va	36.35	57.0	14,584**	1,215	28	5.8	...	13,065	1.107	104.17	10.68	3.59	78.5
Columbia Enameling & Stamping Company, Terre Haute, Ind.	200 Bass W. T.	2	2,000	38.71	1/51.7	108.6	343.2	0.02	1.78	521.8	183.9	Speedwell No. 4 Screenings (Ind.) lumpy and coarse	30.75	41.0	10,556	762.5	19.8	....	...	6,293	1.0698	97.57	8.253	3.36	81.16

*Air leaks in boiler setting. **Dry coal. †Volatile matter (per cent) ‡Fixed carbon (per cent)

Central Stations Prospering in 1916

Gross Earnings During the First Half of the Year Amount to $203,500,000, a Gain of $27,200,000 or 15.6 Per Cent

BASED on the earnings for the first half of the current year, 1916 should be a very prosperous year for the electric light and power industry. According to a compilation made by the ELECTRICAL WORLD from reports received from over 60 per cent of the industry, the earnings from the sale of energy during the first six months of 1916 amounted to $203,500,000, as compared with $176,300,000 for the first half of 1915. The increase was 15.6 per cent. Output for the first half of 1916 over the first half of 1915 increased 24 per cent, being 10,875,000,000 kw.-hr. as compared with 8,775,000,000 kw.-hr. for the first half of 1915.

Returns for the month of June were particularly good, although it is not readily apparent. The percentages of growth are smaller, not because June, 1916, figures are less than normal, but because the June, 1915, figures were in comparison with the figures for previous months relatively greater than they would be under normal conditions. In fact, the June, 1915, output was greater than any previous month since January, 1915.

One thing in particular will be noticed in looking over the June figures in the accompanying tables and

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE-MONTH PERIOD

	Percentage of Industry Represented	Income from the Sale of Energy			Kw.-Hr. Output		
		1915	1914	Per Cent Increase	1915	1914	Per Cent Increase
July	64	18,488,793	17,200,827	7.5	971,699,054	880,768,487	10.4
August	64	17,342,796	16,024,893	8.2	951,752,053	853,381,696	11.3
Sept.	65	18,547,170	17,074,927	8.6	1,003,606,094	871,573,412	15.1
Oct.	65	20,112,813	18,329,490	9.8	1,087,786,658	949,288,459	14.7
Nov.	65	21,899,048	19,720,232	11.6	1,150,669,073	948,704,941	21.3
Dec.	64	23,418,774	20,962,264	11.8	1,230,655,404	1,004,108,399	22.5
		1916	1915		1916	1915	
Jan.	65	25,286,336	22,352,721	13.2	1,200,672,452	984,205,683	22.0
Feb.	65	22,133,485	19,175,537	15.3	1,121,452,738	869,537,132	29.1
March	65	22,027,627	18,722,742	17.8	1,212,363,217	969,888,339	25.2
April	64	21,206,946	18,375,014	15.5	1,137,602,995	920,464,917	23.1
May	63	20,230,748	17,456,496	15.9	1,164,418,499	939,520,766	24.7
June	63	19,774,417	17,116,375	15.6	1,144,292,607	945,309,104	21.2

TABLE III—PERCENTAGE RATE OF INCREASE IN INCOME AND KILOWATT-HOUR OUTPUT FOR UNITED STATES—CITIES GROUPED BY SIZE

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	April	May	June
INCOME:										
Group 1	7.3	8.7	9.8	10.2	10.7	14.1	16.0	13.9	14.4	14.7
Group 2	10.0	11.4	12.8	13.8	21.3	20.0	18.5	17.0	17.9	19.1
Group 3	15.4	23.4	18.0	19.8	18.3	20.7	28.1	24.7	26.2	21.9
Group 4	9.0	8.7	11.9	13.6	13.1	15.7	17.3	17.4	16.0	11.2
Group 5	11.9	5.7	13.0	13.0	7.2	18.5	26.5	16.1	26.7	14.6
OUTPUT:										
Group 1	12.2	10.7	17.0	19.0	19.0	25.4	22.0	20.0	21.3	18.8
Group 2	18.9	21.4	29.0	31.5	28.0	40.6	28.1	25.5	18.4	18.1
Group 3	24.0	27.3	36.0	33.0	33.2	39.6	39.0	37.7	40.0	33.3
Group 4	11.3	13.4	18.0	16.3	22.6	29.7	18.2	22.7	23.3	20.9
Group 5	19.3	1.7	13.4	9.7	8.5	22.4	29.9	32.0	33.2	16.6

TABLE IV—PERCENTAGE RATE OF INCREASE IN INCOME AND KILOWATT-HOUR OUTPUT FOR NEW ENGLAND STATES—CITIES GROUPED ACCORDING TO SIZE

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	April	May	June
INCOME:										
Group 1	10.6	12.7	13.8	14.8	16.5	18.0	21.5	16.0	17.0	16.4
Group 2	10.3	12.6	12.7	16.1	15.4	19.9	19.0	21.2	19.5	23.2
Group 3	14.7	17.3	15.5	22.8	22.1	29.7	38.7	15.5	24.0	18.2
Group 4	10.0	8.8	9.0	9.6	11.3	15.1	18.1	13.2	13.5	6.2
Group 5	5.8	8.3	13.7	23.5	20.6	26.3	54.5	27.6	28.0	19.3
OUTPUT:										
Group 1	19.2	20.8	28.7	26.2	29.0	38.5	30.9	25.0	28.2	30.0
Group 2	21.7	18.3	30.0	26.5	26.0	36.8	27.8	31.4	33.2	31.2
Group 3	14.4	8.7	23.0	22.5	39.5	41.6	49.0	38.1	43.0	15.0
Group 4	9.0	20.6	20.1	18.5	15.0	23.0	17.4	36.1	30.0	25.3
Group 5	8.5	1.8	51.0	14.5	22.6	25.6	58.7	71.8	55.0	27.6

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Industry Represented	New England States			Percentage of Industry Represented	Atlantic States			Percentage of Industry Represented	Central States (Illinois Excluded)			Percentage of Industry Represented	Pacific and Mountain States		
			1915	1914	Per Cent Increase		1915	1914	Per Cent Increase		1915	1914	Per Cent Increase		1915	1914	Per Cent Increase
INCOME	June	60	2,050,896	1,758,561	16.8	67	8,001,052	6,860,849	16.7	55	5,816,298	4,966,554	17.0	87	3,786,435	3,428,011	10.5
	July	66	2,020,513	1,835,968	10.2	68	6,710,217	6,519,442	2.9	56	4,801,699	4,211,641	13.9	88	3,539,168	3,317,713	6.8
	August	63	2,057,635	1,855,140	11.0	68	6,853,118	6,511,307	5.3	56	4,749,082	4,231,322	12.2	88	3,545,454	3,288,729	7.8
	September	66	2,162,064	1,949,663	11.0	68	7,288,842	6,904,245	5.5	57	5,285,358	4,691,751	12.6	88	3,664,215	3,387,717	8.2
	October	66	2,327,214	2,073,059	12.3	68	8,096,982	7,550,808	7.2	57	5,820,653	5,153,314	13.0	88	3,798,012	3,477,051	9.3
	November	66	2,472,539	2,188,049	13.0	67	8,894,805	8,158,589	9.0	57	6,342,582	5,554,226	14.2	88	4,069,995	3,703,124	10.0
	December	66	2,817,557	2,448,813	15.0	67	9,335,396	8,529,866	9.4	57	6,983,909	6,063,349	15.1	88	4,150,045	3,773,810	10.0
			1916	1915			1916	1915			1916	1915			1916	1915	
	January	66	2,819,144	2,432,177	15.0	67	9,589,347	8,564,488	12.0	57	7,834,831	6,717,799	16.6	88	4,182,114	3,823,156	9.4
	February	66	2,599,760	2,185,967	18.8	67	8,978,797	7,854,345	14.3	57	6,660,062	5,568,337	19.7	88	3,761,364	3,443,182	9.3
	March	66	2,595,777	2,122,177	22.0	67	8,998,962	7,660,667	17.5	57	6,470,612	5,394,250	20.1	88	3,787,925	3,386,286	11.9
	April	64	2,221,544	1,898,749	17.0	67	8,794,056	7,596,567	15.8	56	6,289,092	5,292,974	19.0	88	3,825,701	3,520,381	8.8
	May	63	2,098,629	1,783,905	17.7	66	8,226,231	7,131,063	15.4	56	5,985,800	5,032,427	19.0	88	3,864,052	3,461,690	11.7
KW.-HR. OUTPUT	June	60	79,762,083	62,235,683	28.2	67	395,486,337	326,434,627	21.0	55	342,622,351	282,157,287	21.9	87	318,070,497	268,596,102	18.5
	July	66	71,025,184	60,755,381	17.0	68	320,371,761	293,909,832	9.0	56	264,498,989	232,541,585	13.9	88	274,488,534	258,475,004	6.3
	August	63	71,954,506	60,870,433	18.5	68	329,947,721	302,960,234	8.9	56	272,508,518	240,423,753	13.4	88	276,631,551	248,463,980	11.3
	September	66	74,835,203	63,716,224	17.3	68	358,765,971	319,549,780	12.3	57	286,893,057	247,046,941	16.1	88	279,133,989	237,795,633	17.5
	October	66	82,568,951	69,882,867	18.3	68	400,516,741	353,685,472	13.3	57	305,962,017	268,972,416	13.7	88	292,885,613	251,095,356	16.8
	November	66	87,193,883	69,359,620	25.8	67	420,584,253	355,151,259	18.5	57	333,528,905	269,870,536	23.7	88	301,772,412	248,913,893	21.0
	December	66	99,744,195	80,446,521	24.1	67	447,158,465	373,213,316	20.0	57	363,859,444	293,266,707	24.1	88	311,034,100	249,996,678	24.5
			1916	1915			1916	1915			1916	1915			1916	1915	
	January	66	97,072,794	77,029,974	26.2	67	431,201,554	356,809,437	20.8	57	362,121,067	284,407,361	27.5	88	301,645,060	258,982,414	16.5
	February	66	92,855,679	68,982,535	34.8	67	411,715,612	320,924,478	28.1	57	339,326,360	252,816,291	34.1	88	268,653,564	220,662,826	22.1
	March	66	97,321,924	74,958,898	29.9	67	439,660,902	349,347,454	26.0	57	360,872,072	282,179,673	28.0	88	304,327,753	255,450,143	19.3
	April	64	84,769,660	64,816,830	30.8	67	403,223,021	326,574,302	23.4	56	344,866,175	273,367,413	26.4	88	302,386,347	253,778,348	19.2
	May	63	84,578,623	64,213,497	31.6	66	409,529,049	335,858,864	22.0	56	340,384,799	271,415,785	25.3	88	328,085,119	266,506,583	23.1

that is the uniformity of percentage increase in income according to the size of the communities served. The income of companies operating in communities of the

TABLE V—PERCENTAGE RATE OF INCREASE IN INCOME AND KILOWATT-HOUR OUTPUT FOR ATLANTIC STATES—CITIES GROUPED BY SIZE

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	April	May	June
INCOME:										
Group 1.....	4.4	6.2	7.6	8.3	11.1	13.7	16.7	15.1	14.5	16.4
Group 2.....	11.0	11.9	15.0	14.0	18.2	18.4	21.2	18.5	21.7	23.3
Group 3.....	8.9	11.0	10.0	13.1	11.9	14.6	20.5	15.3	17.7	12.0
Group 4.....	10.0	9.8	14.4	15.3	17.4	19.4	17.9	19.5	14.0	15.4
Group 5.....	14.3	10.9	14.6	12.2	16.0	15.8	12.2	15.6	13.0	15.2
OUTPUT:										
Group 1.....	11.6	12.1	16.0	20.1	21.1	30.8	29.2	26.1	25.5	13.1
Group 2.....	16.3	16.8	26.6	25.5	26.4	33.4	25.6	35.6	11.3	33.0
Group 3.....	10.4	15.8	22.1	16.6	20.1	22.0	16.0	13.7	18.0	13.2
Group 4	12.5	14.8	22.0	18.9	15.6	21.8	20.9	19.0	12.6	19.7
Group 5.....	13.8	2.8*	18.6	20.6	1.5	24.0	13.1	8.9	35.0	11.1

*Decrease

same size on the average had increased practically at the same rate.

GROWTH OF POWER LOAD.

Throughout the first half of the current year the factor that stood out most prominently was the remarkable growth in the power load. The demand for

TABLE VI—PERCENTAGE RATE OF INCREASE IN INCOME AND KILOWATT-HOUR OUTPUT FOR CENTRAL STATES—CITIES GROUPED BY SIZE

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	April	May	June
INCOME:										
Group 1.. ...	12.4	12.3	17.0	15.8	14.3	18.3	19.3	18.2	18.0	16.4
Group 2.....	8.6	10.2	10.8	9.8	25.5	20.5	19.1	18.0	18.0	18.2
Group 3.....	22.0	22.7	24.0	25.1	24.3	27.0	23.0	26.7	27.2	20.9
Group 4.....	17.9	16.0	19.8	18.3	9.6	20.2	22.9	22.8	24.0	17.9
Group 5.....	13.5	24.7	9.6	18.0	5.7	11.1	14.4	9.4	21.3	12.6
OUTPUT:										
Group 1.....	15.2	10.4	22.0	21.9	24.9	30.3	25.2	24.7	25.0	23.8
Group 2.....	9.0	14.0	21.5	31.0	28.8	44.0	32.3	23.9	22.5	12.3
Group 3.....	29.3	34.2	43.0	41.2	32.5	44.0	40.6	43.5	41.0	31.3
Group 4.....	29.0	33.5	36.7	18.5	53.4	41.0	31.9	39.2	40.5	41.5
Group 5.....	48.0	3.0	17.3	20.6	13.3	15.9	19.1	10.1	14.7	4.0

power increased in many instances to the point where companies were forced to make extensions to their generating equipment that were not expected to be made for some time. As business expanded the demand for power grew greater. So great was the power demand in June that the total output of the country was a little more than 1 per cent less than the previous high month of the year.

Great as the use of power was during the first half of

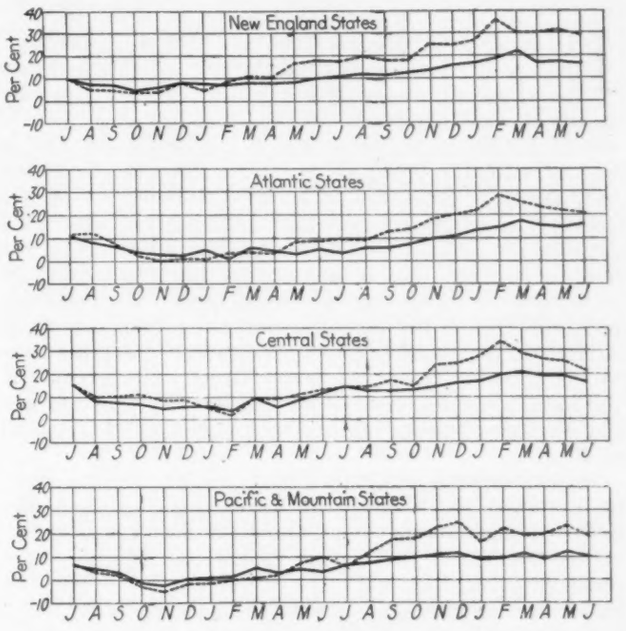
TABLE VII—PERCENTAGE RATE OF INCREASE IN INCOME AND KILOWATT-HOUR OUTPUT FOR PACIFIC AND MOUNTAIN STATES—CITIES GROUPED ACCORDING TO SIZE

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	April	May	June
INCOME:										
Group 1.....	13.9	7.5	7.5	6.0	11.6	6.7	8.5	3.9	7.2	7.0
Group 2.....	11.5	14.3	15.7	17.3	†	†	18.7	3.5*	2.3	1.2
Group 3.....	19.7	21.4	20.0	24.6	19.7	22.0	28.1	40.0	39.0	39.5
Group 4.....	0.3	0.1	4.3	10.8	3.0	8.2	17.5	11.7	13.8	3.6
Group 5.....	15.0	3.1	13.5	3.9	10.5	17.8	26.3	12.0	18.6	12.6
OUTPUT:										
Group 1.....	8.4	7.1	9.9	13.1	9.1	13.0	22.7	8.0	12.0	7.8
Group 2.....	40.3	41.3	51.0	56.0	†	†	28.3	3.6*	2.2	1.0
Group 3.....	49.2	52.4	67.0	67.0	56.0	68.8	39.0	80.0	79.0	74.5
Group 4.....	4.1	1.5	6.2	10.5	1.8	13.8	18.6	10.3	21.8	10.0
Group 5.....	21.0	3.5	8.3	1.0	1.0	20.1	30.0	11.7	33.2	16.6

*Decrease. †Results omitted owing to insufficient returns.

the year much more could have been utilized had there been a sufficient supply of motors. The motor market was simply swamped with orders. Many of the motors ordered at this time will not find their way into industrial use until late in the current year. Consequently the demand for power which has been growing very rapidly will continue to increase considerably for some time.

One gratifying feature of this increased demand is the direction from which a large part of it came. Old customers of central station service, of course, showed a larger consumption but the big increase was from new customers, customers who formerly had been running under their own power. The flood of orders came with such a rush that there was no time to enlarge a private



FIGS. 1 TO 4—CENTRAL STATION INCOME AND OUTPUT GAIN BY MONTHS IN PER CENT SECTIONALLY

plant. Central station service was the quickest and surest and it at once became very popular.

There was not the growth in domestic energy sales in the first half of the year that might be expected under such conditions of national prosperity. This does not mean that there was a very small growth for the use of domestic energy has increased considerably. It does mean, however, that owing to the enormous advance in the cost of wiring a house a smaller number of houses were wired in the first half of 1916 than was expected. A drive made in April and known as the "Wire Your Home Month" accomplished considerable but it was the experience of many of those engaged that the price of copper was a drawback. In fact many contractors and central stations hesitated to push the movement at the prevailing prices.

EXPLANATION OF TABLES

The accompanying curves show graphically the percentages of growth contained in Tables I and II. The remaining tables show the percentages of increase both for income and output for companies grouped accord-

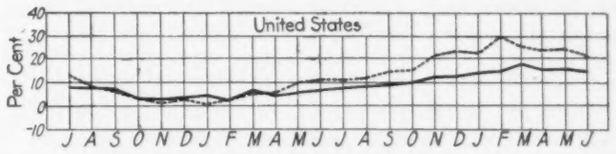


FIG. 5—CENTRAL STATION INCOME AND OUTPUT GAIN BY MONTHS IN PER CENT FOR UNITED STATES

ing to the size of the community served. Group 1 contains those companies operating in cities having a population of over 100,000 inhabitants; group 2 in cities having a population between 50,000 and 100,000; group 3, between 25,000 and 50,000; group 4, between 10,000 and 25,000, and group 5, between 5,000 and 10,000.

Operation of Boilers with Balanced Draft

Comparisons of Test Results When Operating Hand-Fired and Stoker-Fired Boilers With Natural and With Balanced Draft

By R. I. Elkin

In the Aug. 12 issue of the Electrical World, an analysis of combustion conditions was presented when operating boilers with nearly atmospheric pressure in the furnace chamber. In that article it was pointed out that the time during which furnace gases are in contact with the boiler is an element which affects the heat transfer from gas to boiler. A reduction of gas velocity therefore represents a gain in heat absorbing capacity of a boiler that is analogous to increasing the heating surface. In addition to this very real gain there is a further advantage in having lower air velocities passing through the boiler in that the effective heating surface is increased because pockets and other portions of the actual surface not in the direct line of travel of the gases are filled, whereas at higher velocities they are hardly exposed to the high-velocity gases, short-circuited as it were.

Many experts maintain that better results may be obtained by having the gases pass through the boiler at high velocity than can be had at low velocity, on the hypothesis that at low velocities a fringe of gas remains in contact with the boiler surface while the major portion of the gas passes through the boiler without coming into actual contact with the boiler walls. The result of this happening would be, of course, that the outer fringe of gas gives up its heat while the central portion retains its heat in passing into the chimney, and in this way not utilizing a large part of it in the boiler. The exponents of this theory advise high velocities in order that the gases may mix better, attempting by varying the velocity of the gases to obtain what should be obtained by suitable boiler design. Be this as it may, the comparatively slow movement of gas made possible by the system of balanced draft is giving most gratifying results by enabling increased evaporation per pound of coal, permitting in many instances the use of a lower grade of coal than could be used otherwise, lower depreciation and lower maintenance charges, while the smaller coal consumption effects reduced labor costs.

As exemplifying the results that are obtained without and with balanced draft, Fig. 3 is interesting. This diagram shows the control of air to the furnace in a large boiler plant. The upper diagram shows the steam pressure and the position of the flue damper when the furnace was operated by chimney or natural draft controlled by an automatic damper regulator, which holds the pressure within a maximum variation of 3 lb., or 1.5 lb. above and below the mean. The lower diagram shows the same boiler serving the same load, but with the air supply controlled by balanced draft. It will be noticed that in both cases the regulator was set to operate at 135 lb. pressure. By examining the upper diagram it will be seen that when the steam pressure is above the specified amount, namely, 135 lb., the damper starts to close and continues doing so until the steam pressure comes down to 135 lb. Directly the steam goes below this amount the damper starts to open and continues doing so until full open. So far as the regulation of the steam pressure is concerned, this is remarkably good regulation—but it is not at all an economical way to operate. Again looking at this diagram it will be noticed that the space marked with the light shade lines between the steam pressure line and the dotted line, represents the position of the damper, and might be said to represent a condition where there is a deficient amount of air being supplied to the furnace; while the space shown by the shading above the steam pressure line may be said to represent a condition where there is an excess of air being admitted to the fire. The average of these deficiencies and excesses gives the rate of air supply such as is just sufficient to maintain a uniform steam pressure within the prescribed limits for boiler load.

Referring now to the lower diagram, which was obtained from the same boiler serving the same load, but having its supply of air controlled by the system of balanced draft, it will be observed that the variation of the air below and above the theoretical amount is very small indeed, hence the loss in heating value of the coal, due either to incomplete combustion or excess air, is largely eliminated. Moreover, the regulation of steam pressure is equally good in the two cases, therefore the increased economy is not obtained by sacrificing regulation. The very much closer regulation of air, made possible by this method of balanced draft, is due to the damper being slightly above the steam line as the steam pressure is drooping, exercising therefore a

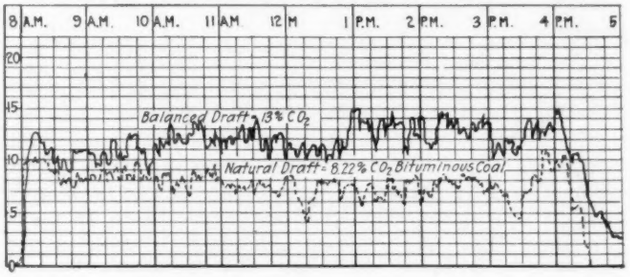


FIG. 1—PERCENTAGE OF CARBON DIOXIDE IN FLUE GAS WITH NATURAL AND WITH BALANCED DRAFT

tendency to check the downward movement of the steam. When the steam pressure is on the increase the damper is slightly below the steam line and the rate of air supply obtained is such that there is a tendency to check the further increase of steam pressure. The result of this is well brought out in the lower diagram, namely, the very small deviation between the amount of air theoretically required and that actually obtained by the boiler for the rate of work being done. These diagrams bring out remarkably well the value of using a blower accurately controlled by the steam pressure and a gas pressure damper regulator of the balanced-draft type controlling the boiler damper. These diagrams show that balanced draft does not necessarily mean that the furnace pressure is balanced with the atmosphere. It does mean, however, that any predetermined pressure is maintained in the furnace for all rates of combustion. This pressure is determined by the conditions of operation—hand-fired or stokered boilers, soft or hard coal, etc. When this pressure is determined the apparatus is set to maintain it for all rates of combustion, in this way producing the maximum efficiency at all times.

Having shown what balanced draft accomplishes in the furnace and the flue, and the manner in which it is done, it now remains to show in what way it affects the cost of operation. The following data from a test on a

hand-fired boiler operating under the same conditions of load without and with balanced draft are instructive:

TABLE I.—RESULTS OF FOUR-HOUR TEST TO DETERMINE ECONOMY OF NATURAL AND BALANCED-DRAFT OPERATION

	Natural Draft	Balanced Draft
Coal, (No. 1 buckwheat) per ton	$3.25	....
Coal, (No. 2 buckwheat) per ton	....	$2.75
Pounds coal consumed during run	7,250	6,500
Water evaporated from and at 212 deg. Fahr. per square foot of heating surface per hour	3.25	3.25
Water evaporated from and at 212 deg. Fahr. per square foot of grate surface per hour	129.87	129.86
Weight of dry coal consumed per square foot of grate surface, pounds	17.9	15.2
Weight of dry coal consumed per horsepower-hour, pounds	4.53	4.04
Water		
Total weight of water fed to boilers, pounds	50,164	50,164
Factor of evaporation	1.0474	1.0478
Equivalent weight of water from and at 212 deg. Fahr., pounds per hour	52,542	52,499
Equivalent weight of water from and at 212 deg. Fahr., pounds per hour	13,135	13,125
Economic Evaporation		
Water actually evaporated per pound of coal as fired, pounds	6.92	7.71
Equivalent water evaporation from and at 212 deg. Fahr. per pound dry coal, pounds	7.62	8.54
Commercial Results		
Horsepower developed	381	380
Builder's rated horsepower	400	400
Per cent of builder's rating developed	93.25	95
Cost to develop 1000 hp.-hr	$7.37	$5.56
Per cent saving accomplished by use of balanced draft over natural draft	....	24.5

An economizer was used in connection with this installation. In both cases the temperature of the water entering the economizer was the same, but the water after passing through the economizer was 19 deg. Fahr. hotter with balanced draft. Moreover, the degree of superheat was 8 deg. Fahr. more, all steam generated being superheated. This test was made under identical conditions as to load, horsepower, etc., showing that the initial temperature of fires with balanced draft was considerably higher, due to more perfect combustion. This test was made on two water tube hand-fired boilers, and the duration of the test was four hours.

The following data were obtained during another test, and gives the comparative results on a chain grate

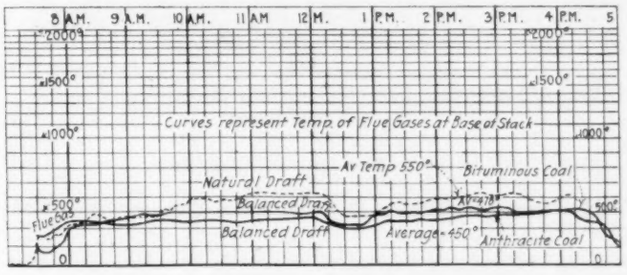


FIG. 2—COMPARISONS OF STACK TEMPERATURES WITH NATURAL AND WITH BALANCED DRAFT

stoker without and with balanced draft, using Illinois bituminous coals (screenings and washed slack) recently carried out at the plant of the Commonwealth Steel Company, Granite City, Ill.:

TABLE II.—RESULTS OF TEST WITH CHAIN GRATE STOKER AND NATURAL AND BALANCED DRAFT

Test number	Natural Draft No. 1	Natural Draft No. 2	Balanced Draft No. 3	Balanced Draft No. 4
Kind of coal	2-in. Screenings	Washed slack	Washed slack	Screenings
B.t.u. dry coal	11,504	11,638	10,326	11,746
Per cent ash	17.16	17.41	21.55	16.28
Pounds dry coal fired	22,930	21,338	19,822	14,653
Water evap. from and at 212 deg. Fahr.	139,689	145,421	149,309	124,488
Evap. from and at 212 deg. Fahr. per pound of dry coal.	6.09	6.81	7.53	8.43
Efficiency of boiler furnace on dry coal, per cent	51.37	56.78	70.72	69.56
Cost of coal, per ton, 2000 lb.	$0.92	$0.92	$0.92	$1.02
Cost to evap. 1000 lb. of water from and at 212 deg. Fahr.	$0.092	$0.086	$0.077	$0.071

The system of balanced draft is not only applicable to single boilers, whether hand-fired or those using chain grates or underfed stokers, but also to whole banks of boilers. There are many advantages in controlling the draft of individual boilers of groups comprising a "bank" by means of balanced draft. The flexibility of the entire boiler room is very materially increased by such individuality of control, as in this way each boiler is controlled in accordance with the conditions existing in its own fire and without cognizance of those of any other fires making up the bank. For example, if one furnace has a thick fire and another a thin fire the

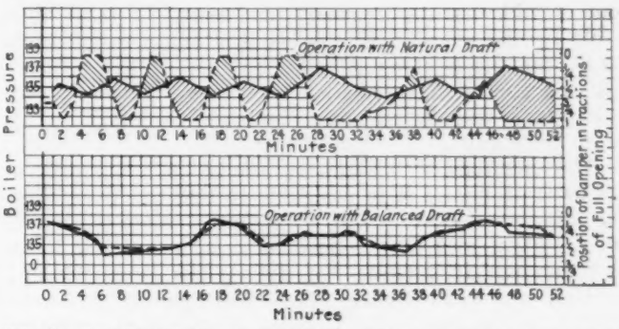

Operation with Natural Draft
Operation with Balanced Draft
Boiler Pressure
Minutes
Position of Damper in Fractions of Full Opening
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52

FIG. 3—CHART SHOWING CONTROL OF AIR TO FURNACES WITH NATURAL AND WITH BALANCED DRAFT

draft conditions of each are controlled in accordance to the demands of its own fire. With large generating units, such as are being used quite universally, each unit is treated as if it were a separate and complete plant in itself, as, in effect, it is. Boilers, exciters, auxiliaries and generator are thus chosen of such capacity that there will result the highest operating economy. Balanced draft assists toward this end because each boiler may be operated at its best economy while carrying its pro rata share of the total load.

There is another factor that has not been mentioned, namely, the handling of a peak load such as practically every central station encounters daily. Balanced draft not only does in no way interfere with the forcing of the boilers, but enables as high as 300 per cent of normal output to be obtained without danger of creating positive pressures in the furnace that might cause ignition of the coal in the hopper. Moreover, the liability of damage following the sudden and intense temperature changes in the boiler settings, the sharp contractions and expansions of boiler tubes that are so costly for upkeep are largely eliminated by the more equitable draft conditions whether the boiler is operating at normal or loads far in excess of normal.

The use of balanced draft imposes practically no additional cost for labor. The power-driven blower requires a little attention, it is true, but it is no more than that given when forced draft is used. In any case the apparatus is designed for boiler rooms, and has been made rugged and accessible for ready inspection and periodic overhauling. Occasional inspection is necessary, as with all other apparatus, but the cost of doing this will be more than counterbalanced by the reduction of labor due to the consumption of less fuel, and therewith less cinders, less clinkers and less soot to be disposed of. The system is as applicable to the small plant as to the large, although, of course, the larger the plant the greater will be the increase in over-all economy. Balanced draft is used on 150 boilers of the Standard Oil Company; on thirty-eight boilers with an aggregate capacity of 21,000 hp. of the Boston Elevated Railway, and with twenty-five boilers aggregating 12,500 hp. at the plant of the Youngstown Sheet & Tube Company. The Stone & Webster Engineering Corporation have so equipped some 60,000 hp. of boilers; and at the present the plans for the unification of the steam plants in Washington, D. C., which will comprise ten 1000 hp. boilers, call for balanced draft.

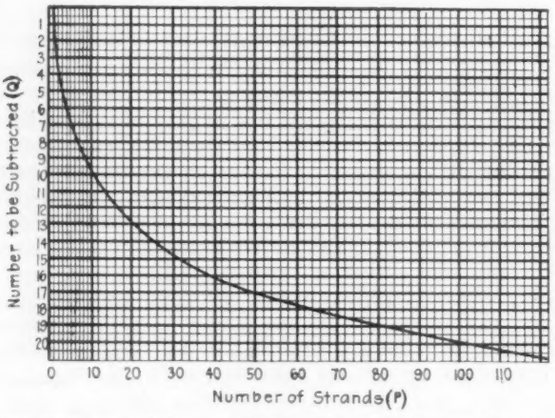
DETERMINING EQUIVALENT GAGE OF STRANDED CABLE

Simple Methods for Finding the Gage Number of a Stranded Cable by Employing Chart or Slide Rule

BY ALFRED B. GOLDSTENE, B.SC.

The usual method of determining the equivalent gage number of a stranded wire is to measure the gage of one strand, find its cross-sectional area in a table, multiply by the number of strands, and again refer to the table for the equivalent gage number of the product. By the use of the accompanying curve, however, only one mental calculation has to be made to determine the equivalent gage.

The method of using the curve is explained as follows: Suppose it is desirable to find the gage number of a conductor having sixty-one strands of No. 25 wire. First look at the horizontal scale marked P for the number of strands and follow the corresponding vertical line to the curve. Then trace the nearest horizontal line to the vertical scale. Subtract the number



CURVE USED IN SHORT-CUT METHOD TO DETERMINE EQUIVALENT GAGE OF CABLE

found there from the gage of one strand and the result will be the gage of a solid wire having the same resistance as the stranded conductor. Sometimes the result will be negative, in which case (— 1) means No. 00 B & S gage (— 2) means No. 000, and (— 3) means No. 0000. For example if a conductor has ninety-one strands of No. 16 wire its gage number will be 16 — 19 = — 3, or No. 0000 B & S gage.

Engineers who find it inconvenient to carry a copy of this curve may obtain almost as accurate results with a slide rule using only the lower scale and the logarithmic scale along the back of the slide as follows: First reverse and invert the slide, making the ends of the movable and stationary scales coincide. Then opposite the number of strands on the lower scale read the nearest figure on the middle scale, prefixing the figure 1 if the number of strands is 10 — 99, and the figure 2 if the number is 100 — 199. Then subtract this number from the gage number of one strand as before and the result will be the equivalent gage of the stranded cable. For instance, assume as before that a conductor has sixty-one strands of No. 25 wire. Then the nearest number opposite 61 is 8, which prefixed by 1 is 18. Subtracting this from 25 will give 7, the same equivalent gage as obtained by use of the curve.

The following analysis gives the mathematical basis for the foregoing methods: Diameters of wires measured by successive sizes on the Brown & Sharpe gage are in geometrical progression, the common ratio being equal to $2^{-1/6}$. The diameter of No. 0 wire is 324.9 mils. Hence, if

n = the gage number of wire, and
D = the diameter of the wire, in mils,

then

$$D = 324.9 \times 2^{-n/6}.$$

Taking logarithms of both sides, and solving for n, we obtain,

$$\log D = \log 324.9 - \frac{n}{6}\log 2; \qquad (1)$$

$$n = \frac{6}{\log 2}\log 324.9 - \frac{6}{\log 2}\log D \qquad (2)$$

Suppose, now, that we have a stranded wire, composed of P strands of number n wire. Then the diameter of a solid wire having the same resistance as the stranded wire is (if the strands are laid parallel to each other) exactly equal to

$$D_p = \sqrt{PD}; \text{ therefore } D = \frac{D_p}{\sqrt{P}} \qquad (3)$$

(If the strands are not laid parallel, but are twisted in the ordinary helical manner, then the relation expressed by equation (3) is very nearly true.)

Substituting, in equation (2), the value of D given by equation (3) we obtain,

$$n = \frac{6}{\log 2}\log 324.9 - \frac{6}{\log 2}\log \frac{D_p}{\sqrt{P}};$$

Expanding

$$n = \frac{6}{\log 2}\log 324.9 - \frac{6}{\log 2}\log D_p \frac{3}{\log 2}\log P$$

From which

$$n - \frac{3}{\log 2}\log P = \frac{6}{\log 2}\log 324.9 - \frac{6}{\log 2}\log D_p \qquad (4)$$

The right-hand members of equations (2) and (4) are identical, except that, in the latter, D is replaced by D_p; hence, the left-hand member of equation (4) expresses the gage number of the solid wire equivalent to the given stranded wire. Calling this number N, we have

$$N = n - \frac{3}{\log 2}\log P \qquad (5)$$

In the common system of logarithms,

$$N = n - 9.97\, log_{01} P; \qquad (6)$$

or,
$$N = n - Q, \qquad (7)$$

where
$$Q = 9.97 \log_{10} P \qquad (8)$$

In these equations n is always a whole number. For most commercial purposes N is taken as the nearest whole number. Hence Q should be a whole number. Therefore, if n and Q be known, N may always be determined by a simple mental calculation. Now n may be readily measured, and Q may be quickly determined from the value of P by means of the accompanying curve, which is plotted with value of P against 9.97 log P $(= Q)$.

It often happens that the number of strands is much greater than the maximum value of P given in the accompanying curve. To provide against such a case, we might plot a curve having a longer range; but this is not necessary. The value of Q may be readily determined if we bear in mind that doubling the right-sectional area is equivalent to decreasing the gage number by 3. (This can be easily proven by reference to equation (1).)

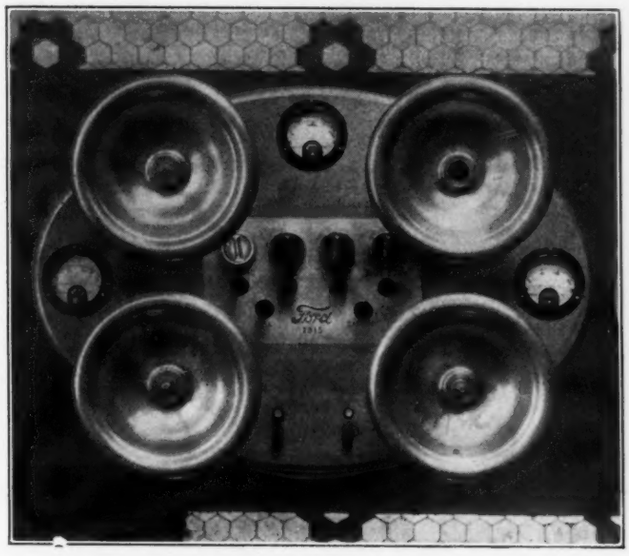
For example, suppose that a given cable contains 900 strands of No. 27 wire. The gage number is three less than if it had contained 450 strands; six less than if it had contained 225 strands; nine less than if it had contained 113.5 strands. But, corresponding to $P = 113.5$ we have, from the curve, $Q = 20$. Hence, when $P = 900$, $Q = 29$. The number of the given cable is, therefore, $N = 27 - 29 = -2 =$ No. 000.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

System of Operating Signals Used in Power Plant of Ford Works

In order to enable the engineer and the switchboard attendant to operate intelligently with each other in the power plant at the Detroit works of the Ford Motor Company, a complete system of signals is provided between each engine and the control section of the switch-



TOP VIEW OF AN ENGINE CONTROL AND SIGNAL BOARD AT OPERATING STAND NEAR EACH GENERATING UNIT IN FORD POWER STATION

board. On the signal board shown in the accompanying illustration, at each engine is mounted an ammeter indicating the generator current, two voltmeters showing the voltage on the respective sides of the 3-wire ignition circuit. A switch is used for completing the ignition circuit independent of the auxiliary switch associated with the generator circuit breaker and four signaling switches with each of which is associated a signal lamp with which is employed a distinctively colored bull's-eye lens.

At the switchboard are installed an identical set of lamps so that the signal given by the engineer lights the corresponding lamp at the signal board as well as at the switchboard. At the latter point a bell rings in order to insure the more prompt attention of the operator. Both the lamps at the signal board and the switchboard remain lighted until the operation called for has been completed. The indications of the respective lamps are as follows: White—engine running—connect generator; green—increase load; amber—decrease load; red—engine trouble—disconnect generator. At the switchboard there are in addition to these signal lamps two others which indicate whether the ignition is completed through the short circuiting switch controlled by the circuit breaker. The need for these is determined by the fact that the generator circuit should only be completed after the ignition and throttle control circuit has been put under control of the circuit breaker, thereby insuring upon the opening of the circuit breaker that the engine will be controlled entirely by steam.

This signal system was developed by Fred Allison, electrical engineer of the Ford Motor Company and is a part of the electrical control for this company's generating plant as described in the Aug. 12 issue of the ELECTRICAL WORLD.

Acquainting Station Employees with Plant Performance

Owing to the numerous uses for exhaust steam relatively economical results are being obtained by a private generating plant serving an industrial load in Connecticut, as shown by the following data:

	January	February	March
Kilowatt-hours generated.....	1,546,750	1,639,313	1,895,557
Boiler efficiency (average), in per cent	71.2	68.7	72.3
Evaporation (actual), in per cent..	8.72	8.81	9.35
Cost per kilowatt-hour (cent).....	0.301	0.289	0.2994

Data of this nature are posted in the form of curves on bulletin boards throughout the plant to acquaint the employees with the results they are assisting in securing and to encourage them to greater efforts.

Four Speed Induction Motor Drive Produces Economies in Manufacture of Lead Cable

At the Hawthorne plant of the Western Electric Company, Chicago, Ill., the hydraulic press pumps used in the process of extruding lead sheath on telephone cables, were formerly driven by direct-connected d.c.

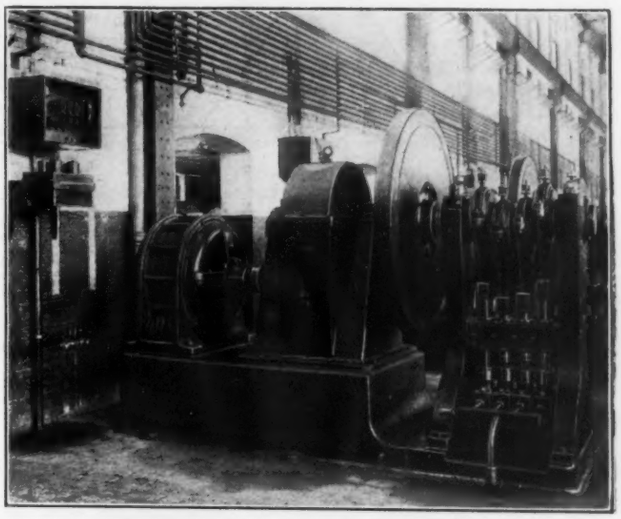


FIG. 1—FOUR SPEED INDUCTION MOTOR GEAR CONNECTED TO HYDRAULIC PUMP. CONTROLLER CONTACTORS AND SOLENOIDS ARE SHOWN ON WALL AT THE LEFT

motors operated at 100 r.p.m. constant speed, the pressure being varied by by-passing more or less water. When the power system in the plant was changed over to alternating-current, it was found desirable to also change the drive of these presses, and at the same time

provide a means of obtaining varying pressures by speed control instead of by by-passing or wasting water. A study which was made of the situation showed that a change to the scheme outlined below would effect sufficient saving for the twenty-one units in the cable department to warrant the expense of making it.

The d.c. motors were displaced by 35-hp. squirrel-cage induction motors connected to the hydraulic pumps through Delaval helical reducing gears, each with a ratio such that the pumps run at 85 r.p.m. when the motors are running at 860 r.p.m. The motor design was made such that by the system of changing the number of poles the four best operating speeds for extruding lead could be obtained. The number of poles is varied by the special pole-changing switch of the company's own design from eight to twelve, sixteen and twenty-four, with corresponding synchronous speeds of 900, 600, 450 and 300 r.p.m. respectively. The pump cylinders were increased in bore slightly to give a little larger output and permit a good gear ratio.

The motors are controlled from four-point, hand-operated master controllers mounted on the side of the presses convenient to the operator. These allow any one of four solenoids to be energized on the pole-changing switch which controls the stator connections and insert resistance momentarily when changing speed to limit the first rush of current. Incandescent lamps placed in parallel with the resistance flash up for an instant upon changing the controller position, and give a visual signal that the solenoid has functioned.

As the completed cable comes through the press, it is reeled up on the familiar large wooden reels, which rest on and between two rollers driven by electric motors. The reel is revolved by perimeter contact. It is important that this reeling process should continue at exactly correct speed, for if the reel runs too fast

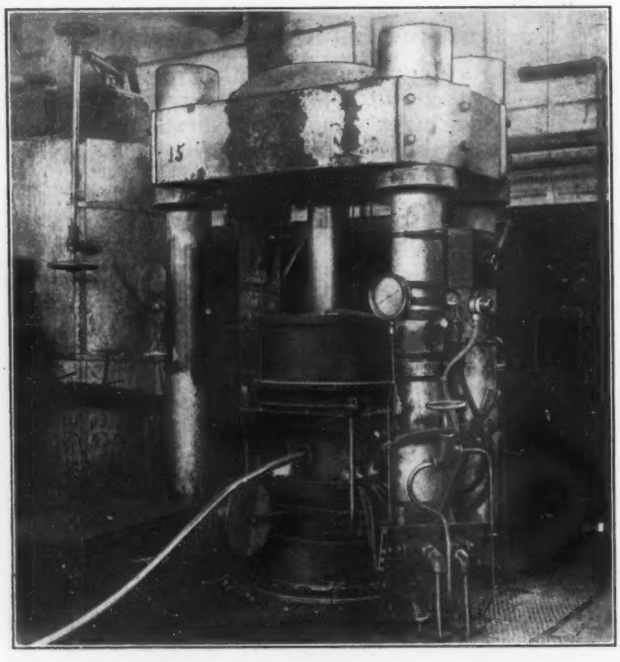
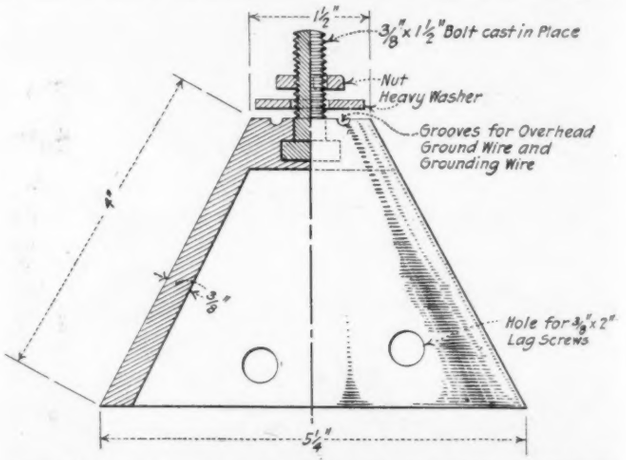


FIG. 2—MASTER HAND CONTROLLER MOUNTED ON SIDE OF HYDRAULIC LEAD EXTRUDING PRESS

and pulls the cable it is likely to draw it and cause thin spots. On the other hand, if it runs too slow, kinks may occur in the sheath, and these are equally undesirable. Hence it is one man's job to govern the speed of the reel and guide the cable as it is wound on the reel. In one hand this man holds a small hand-control switch in which are several push buttons. Pressure on these buttons completes a circuit through a small motor, causing it to rotate in one direction or the other, and by this rotation to cut in or out resistance in the armature and field circuits of the 1½-hp., d.c. motor driving the reel rolls through a worm and gear. This small pilot motor adjusts the resistance in the armature circuit at the lower speeds and in the field circuit at higher speeds, giving a speed range from 200 r.p.m. to 2400 r.p.m. These controlling mechanisms and driving motors are all mounted in pits beneath the floor to avoid any obstructions to the clear space around the presses.

Specially Designed Pole Top Used by Marion (Ind.) Company

The galvanized cast-iron pole top shown in the accompanying illustration is being used by the Marion (Ind.) Light & Heating Company. It is designed to fit a round-topped wooden pole and to be held in place by three ⅜-in. by 2-in. lag screws driven into the pole.



CAST IRON POLE TOP FOR CLAMPING TRANSMISSION LINE OVERHEAD GROUND WIRE

The overhead ground wire and the grounding wire to the butt of the pole are clamped under the washer on the ⅜-in. by 1½-in. bolt which is cast rigidly into the pole-top piece as shown. The points in favor of this design of pole top are that it will permit 90-deg. angles to be turned without special construction, that the grounding wire can be clamped in place instead of being wrapped about the overhead ground wire, and that the pole-top piece protects the top of the pole and the holes made by the pole-top lag screws from the weather.

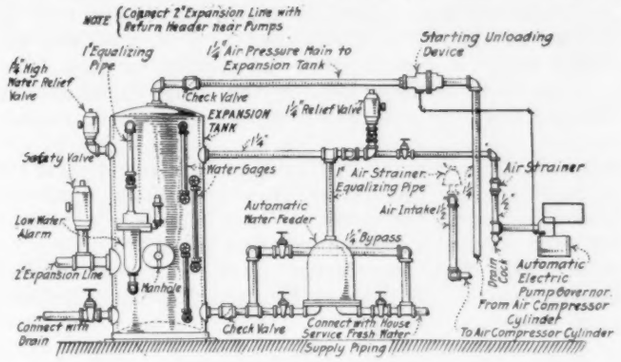
These devices are made for the Marion company in a local foundry and by one of the large pole-line hardware manufacturers. The cost of the last order was $19.10 per 100 pieces f.o.b. Marion, Ind.

Expansion Tank Connections for Forced Hot Water Heating

The general arrangement of connections for a pressure expansion tank of a forced hot water circulation system is shown in the accompanying illustration. A 2-in. expansion line is connected to the return header near the pumps and extended to the expansion tank, at which point a safety valve is installed. The air compressor with a 1.5-in. intake has its suction through an air strainer and discharges through a 1.25-in. line to the top of the expansion tank. This line is equipped with a check valve and a starting and unloading device connected to the automatic electric pump governor, the latter being connected by a ½-in. valved line with

an air strainer to the expansion tank. An automatic water feeder connected with the house service fresh water supply piping provides the necessary make-up as required. This is arranged with a three-valved by-pass and check valve, also with a 1-in. equalizing pipe.

By an arrangement of three two-valved water gages with protective guards the water line may readily be



PIPING AND ARRANGEMENTS FOR INSTALLING PRESSURE EXPANSION TANK

noted, the gages being installed at various heights. An alarm for low water is also installed with a 1-in. equalizing pipe connected thereto and high water relief is effected by the 1¼-in. valve as indicated. The tank is further equipped with the customary manhole of standard size and is provided with a valved drain.

How an A.C. Arc was Used in Scrapping Three Corliss Engines and Generators

BY GEORGE W. TEFFEAU, JR.

When the Llewellyn Iron Company took the contract of dismantling and scrapping three compound Corliss engines and the three 800-kw. direct connected generators in an old railroad powerhouse in Los Angeles, it was discovered that in order to reduce the machinery into pieces small enough to handle a great amount of cutting must be done on the job. It was impracticable to use the oxyacetylene flame for the reason that practically all of the cutting was on cast-iron. To drill and wedge the various pieces apart was a laborious job, and the following method was tried as an experiment.

Two 50 kw. transformers were set up in the engine-room and connected to a single-phase 2200-volt, 50-cycle main, through fuse blocks and an oil switch from the Southern California Edison Company's system. The primaries of the transformers were connected in series while the secondaries were connected in multiple so as to supply 52 volts service. Two 4/0 cables in parallel made up each secondary lead, one lead terminating at a movable holder which consisted of a hollow wooden rod about 5 ft. long to the end of which was fastened a metal clamp for holding a carbon electrode 3 in. in diameter and about 12 in. long. The other lead was made fast to the casting that was to be cut.

In order to prevent abnormal surges on the line, a resistance of about 30 ohms was inserted in series with the primary. With 52 volts on the secondary it was impossible to maintain the arc, especially on heavy cutting, so that the primary connections changed to multiple giving a transformer capacity of 100 kw. with the secondary voltage raised to 110.

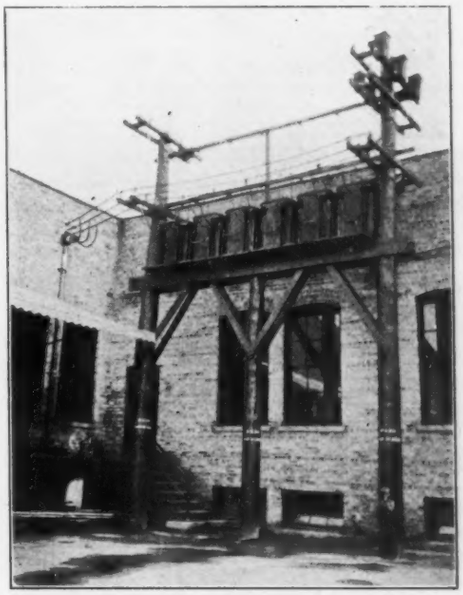
With one man occupied continually with the cutting, the power consumption for about one week's use was approximately 1000 kw.-hr. measured on the primary. With a light cut, such as the spokes of the fly-wheels, collector rings, foundation bolts, piston rods, and the like, the normal current in the primary was about 35 amp. with swings to 100 amp. On heavy cuts, such as armature spiders, bed plates and wheel rims, the current consumption was around 60 amp. with swings as high as 150 amp., measured on the primary.

Since the apparatus used was very crude the time necessary to make the cuts was longer than would be needed on a more refined equipment. To cut a 2-in. foundation bolt it required from three to four minutes depending on the ease with which it was able to approach the work. A cast-iron ring section 25 in. x 1½ in. was cut through in one hour's time. The carbon consumption was a practically negligible quantity except for breakage due to the cumbersome holder. A 3-in. diameter carbon 24 in. long was sufficient for all the cutting that was done in ten days. It is contemplated to install an equipment of this kind as a permanent arrangement, substituting a reactance in the primary in place of the resistance to limit the primary current to ten times full load current of the transformers.

This is the first time the writer knows of an alternating-current arc being used for metal-cutting of the proportions here outlined on a scrap job. While the apparatus was crude, it is very doubtful if a more economical method could have been devised.

Method of Installing Transformers and Fuse Switches

The accompanying illustration shows an installation of transformers and fuse switches for an ice plant in Oak Park, Ill. This installation is typical of construction employed by the Public Service Company of Northern Illinois for its large industrial substations. In this particular case the 4000-volt lines are carried on the top cross-arms and type B Matthews fuse switches mounted on the first cross-arm to isolate the substation. Drops from the high-tension lines extend to insulators on a 4-in. by 4-in. cross timber between poles, and thence



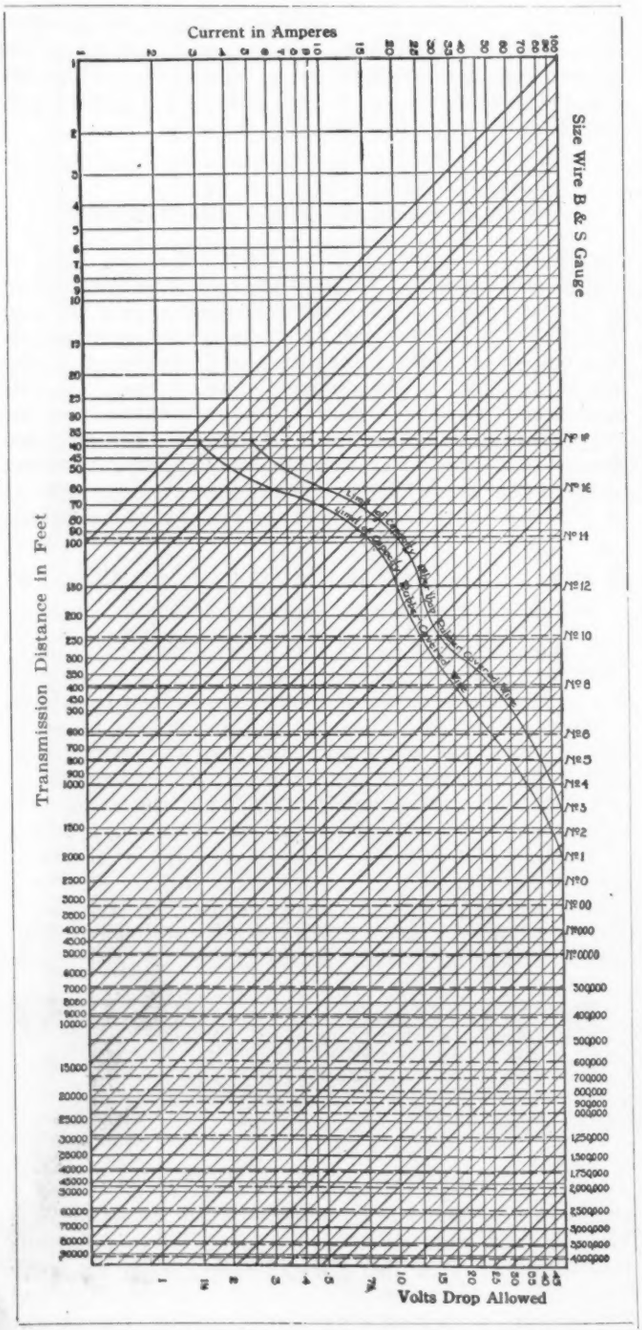
TRANSFORMER STATION AT OAK PARK, ILL., ICE PLANT

down to the six 50-kw. Westinghouse transformers. The 440-volt connections are carried up to the leads into the ice plant, which are spanned between the lower cross-arms. This construction separates the high and low-tension wiring effectively, for within the height of a man the high tension is entirely on one side of

the poles and the low tension on the other. The lightning arresters are mounted on a separate cross-arm just below the fuse switches. The transformers are supported on a platform made up of two 3-in. by 10-in. planks bolted through the poles and braced with 3-in. by 6-in. timbers. The 2-in. by 10-in. floor boards extend out to make a platform on each side from which men can work.

Graphical Method for Calculating Feeder Sizes

By means of the accompanying chart the required size of any feeder can be calculated if the current, allowable voltage drop and distance of transmission are known. The current carrying capacity of different sizes of conductors will not be exceeded if the final reading falls within the portion of the chart diagonally to the right and below the undulating lines, which indicate the current-carrying limits established by the National Electric Code.



COPPER WIRE CHART BASED ON NATIONAL ELECTRICAL CODE RATINGS

The method of using the chart is as follows: From the point where the horizontal line indicating the current to be carried intersects the vertical line indicating the distance of transmission, trace along the oblique line until it intersects the horizontal line indicating the voltage drop allowed. Directly above this point will be found the size of wire required, that is, provided the "volts drop" is always below the undulating lines.

This chart is accurate for the range indicated so long as the code rulings on capacities of wire remain as they are at present. With any revision thereof the only change necessary in the chart to make it accurate is to replot the undulating lines for rubber insulated and other insulated wires. These curves are plotted between maximum current-carrying capacity and size of wire. This chart was devised by G. B. Nichols, and is copyrighted by the Bryant Electric Company, Bridgeport, Conn.

Making a Motor-Driven Pump Installation More Flexible

Since at two stations of the New Orleans (La.) Sewerage and Water Board submerged centrifugal pumps are driven by synchronous motors, it has been found that the prime movers at the board's generating plant require special handling in order to get these pumps under way with the approach of heavy rains. With recent increases in the pumping capacity of the system, it was found impracticable to continue this method of starting, and means had to be devised to enable these pumps to be promptly started by another method.

The method adopted consists in attaching hydraulic cylinders to the suction gates so that these can be handled quickly and safely, and drilling a 30-in. tunnel, so as to connect all of the large pump suctions and that of the board's constant-duty pump. If the suction gates are throttled, the constant-duty pump, which is driven by an induction motor or any of the large pumps that are running, can lower the water behind these gates so as to clear the runners of the other pumps, which can then be easily started with compensators and the gates afterward raised.

Automatically Regulating Ratio Between Stoker and Blower Speeds to Insure Proper Combustion

When the rates of coal feed and air supply to furnaces are not maintained in the proper relation considerable losses may occur due to insufficient or excessive oxygen for proper combustion. At one plant in Bridgeport, Conn., the ratio between fuel feed and air supply is regulated automatically. The blowers supplying air to the furnace are controlled by the steam pressure while the stoker speeds are regulated in turn by the air pressure. Thus when the steam pressure drops due to an increase in load the blowers force more air into the furnaces and the stokers operate faster, feeding enough coal so that practically all the oxygen is utilized in combustion and very little escapes through the chimney carrying away heat that might have been utilized in converting water into steam. The blowers and stokers are operated by steam engines, their speed being regulated by automatic control levers that change the throttle opening. It may be pointed out that the relative speeds of the driving units have to be changed whenever the coal characteristics change appreciably.

COMMERCIAL AND BUSINESS POLICY

A Department of Plans and Methods for Widening the Application of Electricity and for Extending Electric Service

A FREE-WIRING CAMPAIGN THAT PAID ITS WAY

The Marion (Ind.) "Four-Rooms-Wired-Gratis" Plan Which, in Small Town, Secured Many New Users of Electric Service Who Also Purchased Appliances

H. E. Gant, new-business manager of the Marion (Ind.) Light & Heating Company, as the result of a wiring campaign in the town of Sweatzer, near by, has been able to close 109 of the 113 possible electric service customers in the place. Sweatzer is a town of 900 inhabitants, which lies 5 miles from Marion and is served by a 2300-volt, three-phase transmission line.

When the line construction was contemplated the Marion company, co-operating with contractors in Kokomo, Marion and Sweatzer, succeeded in getting about sixty houses and stores wired. Many of these customers were induced to contract for service by the argument that a large number of customers were needed to induce the company to serve the village. To have sold electric service to the rest of the town by straight solicitation would have required a long, hard, uphill pull.

So another plan was tried. Two wiremen with a Ford automobile and a load of wiring material drove to Sweatzer and started house-to-house visits to all unserved premises. They offered to wire four rooms of any house with drop and concealed wiring free of charge. Quite naturally their proposition met instant favor. It was an offer of something for nothing.

SALES OF "EXTRAS" AND APPLIANCES OFFSET COST

Once started on a job, however, these clever wiremen, who also knew something about selling, suggested the convenience of lamps in closets and in pantries and in other rooms not included in the original four. They asked $2 each for the extra rosettes and drop cords. The added ease of operation which a snap switch affords was also demonstrated and switches were included in many installations at an extra charge of $1.50 each.

When a wiring job was finished there was generally time enough for the wiremen to show the lady of the house one or two of the electric appliances that up to this time had been reposing in the automobile outside. Of course, the wiremen were always willing to sell these appliances at list prices, and they found a few buyers for irons and toasters. In fact, they found so many people who could not be satisfied with the bare four-room installation that the profit on "extras" disposed of practically paid the cost of the free wiring. So the company feels highly satisfied with the campaign, since the amount of attention the town now requires from the new-business department is greatly reduced, and the income from the transmission-line investment has increased.

The real secret of success in a campaign of this sort, according to Mr. Gant, lies in the selection of the wiremen. They must be capable wiremen, and at the same time must be salesmen and "sell" enough "extras" to make the jobs pay. There is, however, a contingency which should be guarded against in a campaign of this kind. It should not be started while partial payment wiring debts are still unpaid in the community, for if it is collection troubles on these payments may result. But in communities where patrons owe the company no wiring bills, the free-wiring offer can be justified if it can be shown, as in this case, that only about 60 per cent of those who agreed to wire when it was a question of getting service to the town really did so when it came to "the showdown." The greatest obstacle in the paths of those who have not fulfilled their agreements, it may be pointed out, has been one of inadequate finances. So the company, in order to make the line pay its way, has generously proposed this free-wiring-for-four-rooms plan. This line of argument generally satisfies anyone prone to criticise, but it was not often needed, for criticisms of the plan were very few.

A Fixed Bill of $4 for the First Month's Use of the New Electric Range

A show window of the Benton Harbor-St. Joseph (Mich.) Railway & Light Company, containing an electric range which has done seven years of daily service in the home of John A. Cavanaugh, the company's superintendent of light and power, has been attracting much attention. The old range, which has been taken out, is now replaced with a modern unit, but the change in equipment was the occasion for Mr. Cavanaugh to tell of some of the things he has learned in seven years' experience with electric cooking. He said:

"As the result of experience we now sell ranges at cost to us, plus $5 to cover the cost of installation. Our company does the wiring. At the end of the first month

TYPES OF DWELLINGS WIRED FOR ELECTRIC LIGHT UNDER THE "FOUR-ROOMS-WIRED-FREE" PLAN OF THE MARION (IND.) ELECTRIC COMPANY

A WINDOW THAT ILLUSTRATED SEVEN YEARS' PROGRESS IN ELECTRIC-RANGE MAKING

the range is in we render a bill for $4 regardless of what the meter indicates. This $4 practically never covers the first month's energy cost, but we do not believe in letting a first month's staggeringly high bill scare a customer into taking a range out.

TRAINING THE CUSTOMER IN ECONOMY

"To keep the second month's bill from again running high, we educate the people to the proper use of the range. Our demonstrator shows the women how to save electrical energy by heating dish-washing water in the oven with the heat stored there in the preparation of a roast. We discourage extensive use of fried foods.

"We use the greatest care in selecting the people to whom we sell electric ranges. We never sell them to people who cannot afford them. Our salesmen are not allowed to tell customers that electric cooking is cheaper than gas or oil. They say that electric cooking is better than gas or oil. One range sale to a person who cannot afford higher-priced cooking, does more harm than ten sales to people who can afford it can ever offset.

SOME TYPICAL ELECTRIC-COOKING BILLS

"To give an idea of the amount of revenue electric-range customers bring to our company we may take, for example, data on the monthly bills of eleven of our customers. The lowest bill, which was for 32 kw.-hr., came from a family of two. The highest bill, from a family of twelve with two maids, amounted to $9.69. They used 246 kw.-hr. The average of these eleven customers' energy consumption was 108 kw.-hr., and their bills $4.68.

"I believe that the electric-range load, if the customers are properly educated, is an off-peak load. It has proved to be such in our case, and we have seldom had to install extra transformers to take care of range loads."

A Campaign Plan That Offered Free Electric Units in Exchange for Gas "Arcs"

Following various campaigns in Cincinnati to secure electric lighting business from commercial customers which would mean the displacing of gas "arcs," it became apparent that the public could not easily be induced to make the necessary expenditures to purchase the electric units plus the cost of wiring necessary to install them properly. At this juncture the Union Company, according to W. A. Wadsworth, commercial manager, concluded that it would be feasible to furnish suitable units free. With this in view, prices on four types of lighting units were obtained—one semi-indirect unit, two direct units, and one outdoor unit, all equipped with 300-watt lamps—which cost, installed complete, including lamp and pull-chain switch, not more than $5. The company management believed that it could afford to give a customer one of these units, provided it could be assured of the revenue which the unit would produce if continued in operation for at least one year. With this in mind a proposition in the following form, which constituted a contract, was announced:

APPLIANCE CONTRACT

(Date).....19..

The undersigned hereby requests the Gas & Electric Appliance Company (the appliance sales company of the Union Gas & Electric Company), to furnish.....

.....

Equipped with.....

.....

At premises.....

It being understood and agreed that all appliances and attachments furnished under this agreement are and shall remain the property of the Gas & Electric Appliance Company until the expiration of twelve (12) months from date of installation, when they shall become the property of the consumer; provided, however, that the consumer shall give to the Gas & Electric Appliance Company at the time the electric units are installed, permission to remove and retain one (1) gas arc for each electric unit, and also provided that the electric units are used during the twelve (12) months they remain the property of the Gas & Electric Appliance Company and are not replaced with any other units.

The Gas & Electric Appliance Company will maintain these units and furnish free renewals of lamps during the period the units remain its property. The consumer, however, shall use reasonable care to protect the units while in his possession and shall pay for renewals or broken parts required due to accident or negligence on the part of the consumer.

The consumer shall not sell or remove these units, or any parts of the same, without the written consent of the Gas & Electric Appliance Company.

The revenue from one of these units was estimated as follows: On the basis of 300 watts demand operating four hours per day, 300 days per year, the annual consumption would amount to 360 kw.-hr. This energy at 5 cents would amount to $18 per year, or $60 per kilowatt connected. Under the above-mentioned arrangement the estimated cost of these units for twelve months was as follows:

Unit complete and hung	$5
Selling expense	2
Renewal and maintenance	3
Total	$10

Compared with the usual basis justifying a company investment equivalent to the revenue received from one to two years' use, the proposition easily comes within the limit of average practice. In fact, the offer proved even better than the figures indicate, because the cost of the unit is subject to a credit for the amount received from the gas arc, which will average about $1.50. Moreover, the tendency would be for the customer to continue to use these or other electric units after he has become accustomed to the advantages of electric service.

In two months this campaign resulted in replacing 1000 gas "arcs" and a considerable number of gas burners. An important feature of the campaign was that 120 concerns that were using very little or no electric service have wired the principal parts of their stores and are now using electric service either chiefly or exclusively.

On the assumption that 5000 gas arcs could be replaced, the result reached by Mr. Wadsworth is as follows:

Cost of 5000 units installed and maintained for one year	$50,000
Revenue for one year	90,000
Kilowatts connected	1,500

"Add to this the 'intangible assets' and the proposition is one that offers food for thought. In the case of our company," he continues, "it has not only done all that was expected of it, but it has proven a very decisive blow to the gas arc and has made an attractive increase in commercial lighting revenue."

FOR A BETTER UNDERSTANDING

President Wagner of the N. E. L. A. Discusses the Relationship of the Central Station, the Municipal Electrician and the Public

During the sessions of the International Association of Municipal Electricians held in Baltimore, Aug. 22 to 25, a notable occasion was the reception tendered to the visiting electrical men by the Baltimore Consolidated company section of the National Electric Light Association, when the president of the N. E. L. A., Herbert A. Wagner, president of the Consolidated company of Baltimore, addressed the joint meeting concerning the desirability of promoting better understanding between the electric lighting companies and the municipal electricians of the country, and outlined the possible scope of relationship between the two great societies.

BENEFITS TO THE COMMUNITY

"You municipal electricians, in your functions of supervising the installation of electric wiring and devices in streets, houses and buildings, for lighting, telephone, telegraph, and fire alarm service, represent local government," said Mr. Wagner.

"The function of government is to make laws and to administer them; in other words to regulate. The function of the corporation is to produce and to distribute. Fairly operated corporations are a benefit and a necessity to the community. Fair regulation is a benefit and a necessity alike to the corporations and to the community. The modern corporation welcomes your regulation, and I am sure that rather than tolerating, you are welcoming and co-operating with the modern central station corporation.

"The basis for this co-operation should not be the self-interest of either the central station, or the municipality and its representatives, nor of political party, but rather the greatest good to the public.

THREE PARTIES TO THE UNDERSTANDING

"With better understanding between the corporations, the municipal representatives, and the public, there can eventually be obtained, the highest efficiency, the best and fairest rates for electricity supply, and the best results to the municipality in the way of taxes and the growth of revenue through the rapid growth of the public service corporations. On the other hand, such mutual understanding with fair regulation, co-operation, and fairness in dealing, will bring the best results to the stockholders of the corporation.

"Consequently, we central station men want to co-operate with you municipal electricians in every way possible to bring about the fairest understanding and the highest efficiency in our work. To a large extent our interests are one, in that we are both serving the public, and we should surely want to serve the public in the way to bring about the greatest and best results to all concerned."

Paterson, N. J., Will Hereafter Buy Only Electric Fire Trucks

Following exhaustive tests of electric vehicles and other types of trucks for transporting its fire department apparatus, the Paterson (N. J.) fire board, of which F. H. Schilke is chairman, has voted that all future additions to the Paterson department shall be electrically driven. The board recently opened bids for twelve different electric tractors for hauling combination chemical and hose wagons, steam pumping engines, and aerial trucks.

Wiring and Illumination

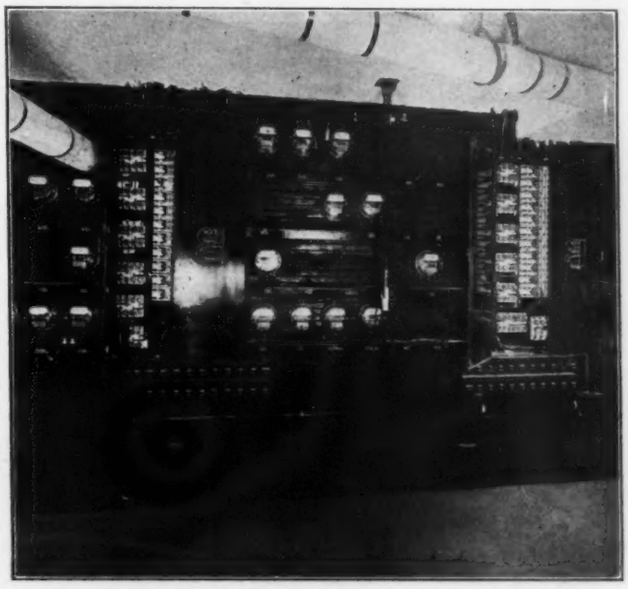
Latest Practice in the Electrical Contracting Field and in the Art of Interior and Exterior Illumination

Apartment House Meter Board with Special Washing-Machine Circuits

In several Minneapolis, Minn., apartment buildings the owner has installed electric washing machines as part of the equipment of the structures. The buildings contain respectively forty-four, nineteen and twenty-one apartments, and the washers are arranged to be used at will by any tenant, who simply pays for the energy consumed. The machines are located in the common laundry room in the basement and each tenant is assigned a certain day on which to wash; but the four washing machines installed and the several tubs make it possible for four or more family washings to be in progress at once.

The wiring installation which makes it impossible for any tenant to use the machine except when supplied with energy through her own meter is very interesting. Just below the fuse cabinets, and connected to them by conduits, are two special steel cabinets with twenty-two individual lock doors. Each cabinet door is numbered to correspond with the numbering system of the different apartments, wherein the same number appears on the mail boxes, telephones, meters and other things common to each apartment. Behind each door of the cabinet, and practically in contact with it, is a porcelain plug connected in circuit with the meter for the corresponding apartment. Into this plug the tenant inserts in one of four leads, say No. 1, which are run in conduit around to the laundry room, a distance of 75 ft., and then goes to the laundry room and connects the other end of circuit No. 1 with one of the washing machines.

When the tenant has finished she pulls the connection from her cabinet and locks the door, and the porcelain plug block is so close to the door that it is im-



ANY ONE OF THE FOUR WASHING MACHINES IN THE BASEMENT LAUNDRY CAN BE OPERATED FROM THE METER CIRCUIT OF ANY TENANT.

possible for anyone else to make connection through it from an adjacent cabinet opening except by opening the cabinet door.

The service board in this apartment is also unusual. Space is provided for the forty-four meters to be installed in three tiers on the wall where the service mains enter, and these are connected to the two fuse cabinets and cut-out panels by a line of conduit just below each row of meters. This conduit, which is a 3-in. square steel trough, is fitted with a fiber top, through which holes are drilled for the leads to each meter. Had the usual conduit been used it would have required 176 bushings, while with the fiber top it was only necessary to bore the holes the size of the wire and pull the wire through, thus introducing a material saving in the installation cost.

On similar installations which were made later, a scheme was found for keeping the fiber from warping due to dampness of the basement. The meters are set close to these troughs so that there is only a very short piece of exposed wiring, and this is the only exposed wiring in the whole building. The layout of this installation and the special cabinet and all electrical work were designed and installed by the Beck Electrical Construction Company of Minneapolis.

Low-Cost Street Lighting System Makes Michigan Town Attractive

To the traveler passing through northern Michigan by night Cadillac's new street lighting system attracts immediate attention because of its beauty and good illumination. The installation was engineered and installed by the Consumers Power Company, of which George D. Westover is district manager, but was paid for by the Retail Merchants Association. After it was all completed and operating it was presented to the city. It comprises 101 Cutter ornamental posts spaced an average of 108 ft. apart and set opposite each other. Each of these posts is equipped with a 250-watt 7.5-amp gas-filled lamp, burned tip-up, and Solux senior tops.

The lamps are fed through standard underground armored cable with No. 6 conductor furnished by the M. B. Austin Company, Chicago. This is laid beneath the bitulithic pavement, in a trench 4 in. wide. This trench was cut into the pavement next to the cement gutter, to a depth sufficient to hold the cable and the pavement relaid over it. In the brick pavement, the half and whole length bricks next to the cement gutter were removed, the cable placed in the sand cushion beneath, and the bricks replaced. On residential streets the cable was laid in a trench 1 ft. deep and 1 ft. wide in the parkway. The posts in all cases were set on separate cement blocks, through which openings were laid for the cable to enter, and in which anchor posts for whole bolts were set.

Energy is supplied by the central station company over a 7.5-amp. constant-current circuit on a charge basis of $14.50 per post year for 11 o'clock service, and $28.50 for all night service. The total cost of the installation was $6,775—a unit cost of $67.

Future Electric Heating Demands May Eclipse Even Power Load

In an interview, Milan R. Bump, chief engineer for H. L. Doherty & Company, recently commented on the increasing demand for electric service in the field of wholesale power.

"But," declared Mr. Bump, "apparently a new period of still wider development, particularly in our manufacturing sections, is now well on the way toward accomplishment. I refer to the use of electricity for heating purposes in steel plants, enameling ovens of all classes, metal heating and melting processes, etc.

"In some towns this field is so large as to eclipse the field for power sold through motors. I have in mind an analysis made recently in a town of 20,000 people in Ohio which indicated that it seemed feasible to secure a load of at least 40,000 kw. of this class. This capacity, a few years ago, would have been ample to supply the electrical needs of a city with a population of 500,000.

"It is, therefore, with a confidence gained by actual demonstration of the possibilities, that I feel safe in saying that there never has been a time in the history of the electrical industry when the outlook for percentage of growth during a coming period was better than it is to-day."

NEW ORNAMENTAL LIGHTING SYSTEM IN BUSINESS DISTRICT OF CADILLAC, MICH.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

TESTS ON SUBSTITUTE FOR OIL IN HIGH-TENSION SWITCHES

Results of an Investigation of Operation of Oil Switches When Carbon Tetrachloride Is Used Alone and with Oil

THE possibility of explosion in oil switches has been largely eliminated by improvements in design, although the inflammable nature of oil is always a source of danger in case of fire, since fire fighting is seriously impeded when a considerable quantity of oil takes fire. Recent experiments conducted by M. Vogelsang in Germany and reported in the Elektrotechnische Zeitschrift, Vol. 12, 1916, have dealt with the possibility of a substitute for oil that might be used in oil switches.

The properties of carbon tetrachloride known under

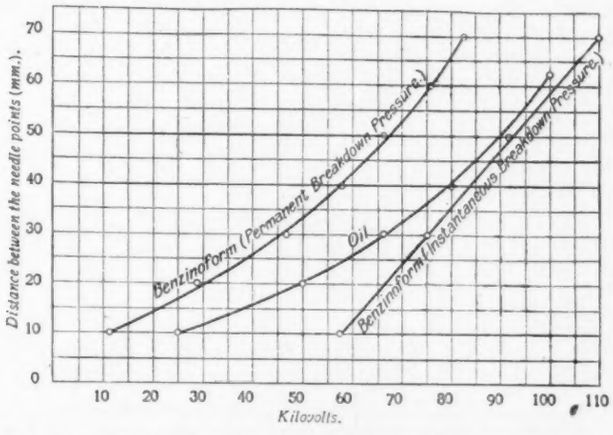


FIG. 1—COMPARATIVE RESULTS OF BREAKDOWN TESTS IN OIL AND CARBON TETRACHLORIDE

the name of benzinoform were investigated. The possible use of this substitute was originally suggested by E. Peyrusson of Paris, in his German patent 218,399, dated December, 1908, which has since expired.

Results of tests carried out to determine its insulating properties are shown in Fig. 1. A great difference was found according as the breakdown voltage was applied permanently or momentarily. The spark passed between needle-points. One curve shows the breakdown voltage required to break down the medium at once, that is, within two seconds; the other shows the breakdown voltage which just suffices to produce the effect in twenty minutes. The tests were scarcely exhaustive, but sufficient to establish the fact that the fluid was quite suitable for use on high voltages. The fact that it behaves very well on momentary surges is very useful because, in practice, surges of this character constitute the real danger. Electrification causes a considerable commotion in the fluid. This is also the case with oil, but not to the same extent, and this may explain the differences in the breakdown voltages noticed in the curves.

In September, 1914, a switch, filled with benzinoform, and covered with a layer of glycerine, was placed into steady use in the test room. It was kept under steady observation through a glass window. The first important fact that was noted was of a decidedly unsatisfactory nature. Within a month all the copper parts were covered with a slimy green layer. But this was found to be due to the glycerine, and to have nothing to do with the insulating fluid itself. The ordinary type of oil switch cannot therefore be used with benzinoform, if a layer of glycerine is used. This switch was used on very different pressures up to 10,000 volts; the ordinary pressure was about 5000 volts. After six weeks, there was a flash-over on 5000 volts, which took place between the copper and the glycerine. The switch was then replaced by another, in which the insulators were deeper immersed in the fluid. Up to the end of 1914, short-circuits were made daily, and nothing happened till the end of March, 1915, when another accident occurred. It was then found that the level of the fluid had fallen 26mm. in consequence of a slight leakage in the case, and it may be remarked that such leakages cannot be noticed from the outside, on account of the volatility of the fluid. This is quite different from oil; there the leakage of a few drops always causes an oily patch, which is easily noticed.

The tests conducted with this old type of oil switch were of interest, as it was very frequently used on very different pressures. It was used in connection with a transformer, which took about 50 kva., but it was not connected immediately to the network. It was therefore considered desirable to connect it to the 3000-volt single-phase supply from a central station. The plant was supplied with direct-current through a group of converters. Four switches for the converters were filled with benzinoform in the spring of 1915. The switch connected to a 220-kw. transformer was most frequently used; and it was also the one with which most of the trouble took place. After some days, it refused to work; this was found to be due to defective lubrication; ordinarily the oil lubricates the contacts. The strength of the springs was adjusted; but the same thing happened again soon after. The strength of the cut-out coil was increased, and the trouble ceased. One night the whole room was filled with vapour, and this was thought to be due to the glycerine. The switch was then cleaned out, but the same thing happened again, and was doubtless due to the frequent use of the switch and the consequent agitation of the layer of glycerine which was used with the benzinoform.

It seemed desirable to see how a switch of this type could deal with a serious short-circuit, and arrangements were made to carry out a test on a machine giving 1100-kw. single-phase power at 3000 volts; it was driven by steam power with a reciprocating engine. The test was made as severe as possible, in view of the fact that the voltage was not very high. The switch chamber contained 75 litres of fluid, the distance from the contacts to the surface of the glycerine was 195 mm., and the depth of the layer of glycerine was 18mm. The precise nature of the adjustments and arrangements are described by the author in some detail. Suffice it to say that a three-pole switch was

adapted unsymmetrically to the purpose, and that the tests were fairly satisfactory in their results up to pressures of 3250 volts. There was a considerable excess of vapour pressure in the box when the switch operated, and the metallic parts were in places attacked by the arc. The contact pieces were in some measure covered partially with a black deposit which could be easily removed by the finger. But more particularly was there a sign of defective lubrication of the contacts, which was very noticeable when compared with oil; and this effect has been already noticed. It is therefore necessary to increase the strength of the springs, if the switch is to operate with certainty on a short-circuit.

From the preliminary tests it is concluded that benzinoform is not in all respects a satisfactory substitute for oil. The volatile nature of the fluid and the probable necessity of using glycerine to prevent it seems likely to cause trouble in practice. A closed type of switch seems most suitable, in which the leading-in insulators are at the bottom. This kind can generally be so designed that the moving parts, which pass through the layer of glycerine, can be limited to a rod; and this diminishes the difficulties due to the glycerine. A mixture of benzinoform with oil may constitute an improvement on the use of oil alone, but it cannot be regarded as doing away with the risk of fire entirely, or even more than very partially. It has long been supposed that inflammability and insulating capacity must necessarily go together in an oil, and thus it seemed that any oil, suitable for a high-tension switch, must expose the installation to a certain fire risk. But the above facts and experiments seem to show that this is not the case, and that a practical solution of the problem is quite within the bounds of possibility. Abstracted from *Elek. Zeit.*, Vol. 12, 1916, in *London Electrician*, July 21, 1916.

Generators, Motors and Transformers

Adjustable-Speed Induction Motors.—A description of a new motor which is built under F. Creedy's patents. Being otherwise identical with the squirrel-cage induction motor, it has a drum-wound stator or primary, divided into a number of sections which can be connected in either "mesh" or "star." From each section a terminal is brought out, which connects through a suitable controller to a phase converter, consisting of a specially wound transformer, whose function is to convert from the two- or three-phase line current, to a number of phases equal to that of the sections in the motor winding. By the use of this phase converter and a suitable controller, it is possible to vary the phase difference between adjacent sections of the stator winding in such a way as to produce any desired polarity. In Fig. 2 is shown such a winding, having thirteen terminals connected to a phase converter, giving thirteen phases, in such a manner as to give two, four or six poles. If every terminal of the motor is connected in order to the corresponding terminal of the phase converter, the phase difference between the adjacent sections of the motor will be the same as that of adjacent sections of the phase converter (that is, 360 divided by 13 in the case shown), when the motor will operate as a bipolar machine. If the motor terminals, starting from a given point, are connected to every second converter terminal, the phase difference between the sections will be doubled, and the motor will operate with four poles. Similarly, if the motor terminals are connected to every third phase-converter terminal, the phase difference between adjacent sections will be tripled, and the motor will operate with six poles, and so on. By the use of a machine operating on these principles the following advantages are secured: Variable-speed machines can be supplied in all sizes up to the very largest without incurring commutating troubles, and, in fact, without departing from standard induction-motor practice. The well-known advantages of the standard induction motor are retained. Although more terminals and wiring are used than in single-speed three-phase motors, the wiring is correspondingly reduced in section, so that the total cross-section of copper in the wiring is exactly the same as in a standard machine, and thus has only half the section required for a two-speed machine, with two separate windings. The whole of the stator winding is always in use, so that there is no dead copper on the stator, as in the two-speed motor just mentioned. It is possible to offer a larger number of steps in speed, from six in the 15-hp. size up to nine in the 100-hp. size, and even more in larger sizes, instead of two or three only. The controller and phase-converter form a separate unit, which can be placed at any convenient distance from the motor. The difficulty as regards starting squirrel-cage motors is comparatively overcome, so that 3-to-1 speed range machines, of the squirrel-cage type, can be guaranteed to start at full-load torque, with not exceeding twice full-load current. As compared with direct-current variable-speed interpole shunt motors, the motor is capable of giving the same torque at all speeds, and consequently power pro-

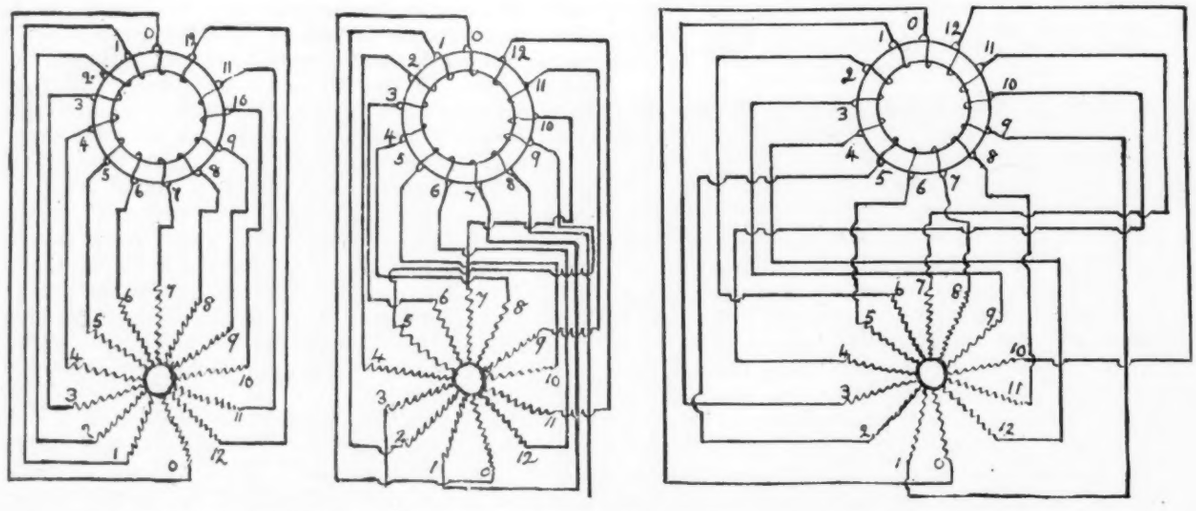


FIG. 2—CONNECTIONS OF CREEDY MOTOR AND PHASE CONVERTER FOR TWO, FOUR AND SIX POLES

portional to the speed. It is claimed, therefore, that the natural characteristics of the motor correspond much more closely with those of ordinary industrial machinery than do the characteristics of direct-current motors.—London *Elec. Rev.*, July 14, 1916.

Lamps and Lighting

Lamps on Electric Vehicles.—In the report of the electric vehicle committee of the (British) Incorporated Municipal Electrical Association it is stated that the committee jointly with representatives of the Tungsten Lamp Association, has considered the question of the size of bulbs, and the voltage of incandescent lamps for use on electric vehicles. The result of the joint deliberation was the issuing of a recommendation that the standard voltage should be considered as 12 volts, the lamps to be coupled across a section of six cells in a leadplate battery or the equivalent number in a nickel-iron-alkali battery. It was recommended that the sizes of bulbs should be those fixed by the British Engineering Standards Committee in their report, No. 69.—London *Electrician*, June 30, 1916.

Installations, Systems and Appliances

Switch Gear Control.—A. G. COLLIS.—An illustrated article in two sections which deals with the standardization of switch gear and developments in protective apparatus designed to reduce complications that are sometimes unnecessarily introduced. The author takes up in the first section the operation of a combination relay. This relay is designed to open the circuit at (1) a predetermined overload, (2) failure of pressure; and, in addition, to open (3) under a predetermined reversal of energy or current. Its use depends upon current and potential transformers with a secondary adjustable resistance. The potential transformer *D* (Fig. 3) and the current transformer *C* are connected in the mains *A*, the adjustable resistance *E* being inserted in the secondary of the potential transformer *D*, of which the secondary of the current transformer *C* and the relay *F* form part of the circuit. The relay *F* is connected across the closed secondary circuit, the windings of which operate a moving element, which closes or opens contacts connected to the automatic features *H* of the circuit breaker *B*. Under ordinary working conditions the currents set up in the secondaries of the current and potential transformers are to a certain extent balanced and so adjusted that no effective current passes through the relay circuit. When the direction of current is reversed in the primary mains, the currents in the relay circuit are additional, and their value is determined by the variable resistance. The effect of an overload or drop in volts when the flow of energy is in the normal direction in the high-tension mains introduces an out-of-balance of secondary currents between the potential and current circuits, the relationship of which is predetermined by the variable resistance. The difference of these values passes through the relay circuit operating the moving element, and, in turn, closing the automatic features of the high-tension switch opening the circuit. In this relay there are two methods of adjustment—one by the variable resistance in the secondary circuit and the other by varying the tripping current of the relay, thus giving a wide range of operations. It is not possible to open circuit on reverse only or for overload only, or for the apparatus to act as a pressure drop device separately from the other features. In some instances the combination would be very undesirable. The theories of usual English practice, however, are in a transition stage, and it is expected that the utility of this combination will have a much wider scope in the future. The question of selectiveness can be added to the relay itself, as cases may determine. Wattmeter relays are also discussed and general remarks offered on features of design and control of relays to satisfy certain operating requirements. Under the heading of special protective gear reference is made to arrangement for the isolation of faults on any section of supply without disturbing feeders. A brief comment is also offered on the operation of oil switches, break switches and the design of switchboards.—London *Engineer*, July 21 and 28, 1916.

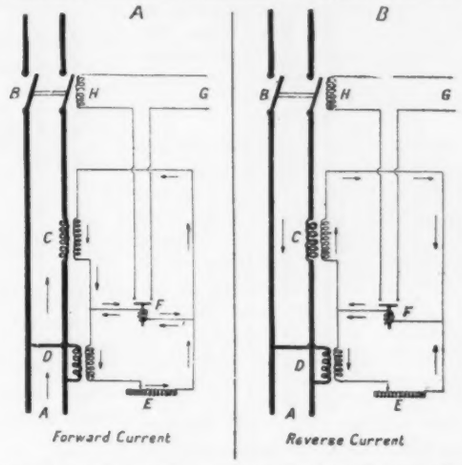


FIG. 3—OPERATION OF THE COMBINATION RELAY

Electrochemistry and Batteries

Radium from Carnotite.—HERMAN SCHLUNDT.—An account of some experiments on the extraction of radium from carnotite ores with concentrated sulphuric acid. The carnotites consist of a sandstone with a clay binder variably impregnated with the mineral carnotite, a hydrous potassium uranium vanadate containing barium and calcium. By boiling carnotite ores with concentrated sulphuric acid the barium and radium compounds present are converted into bisulphates which remain in solution in an excess of the acid, and may then be separated from the insoluble components by filtration followed by washing the residue with concentrated sulphuric acid. From the acid liquors thus obtained the radium is recovered by diluting with water, whereby barium-radium sulphate is precipitated.—*Journ. Phys. Chem.*, June, 1916.

Telegraphy, Telephony and Signals

Impulse Excitation Transmitter.—ELLERY W. STONE.—A paper in which ideal "impulse excitation," as opposed to the usual quenching gap phenomena, is described. The best conditions for impulse excitation are explained. The development of a rotary sectored gap of small separation operating in a hydrocarbon atmosphere, is considered. A 2500-volt, 60-cycle transformer charges a large capacity which discharges through the gap and a small inductance. Effective impulse excitation requires about 2400 r.p.m. of the gap or more. Using alcohol vapor, an adjustable pressure valve must be fitted to the gap to prevent excessive pressures which raise the gap voltage inordinately. A complete 2-kw. transmitter of this type is described. The antenna circuit need not be in tune with the closed circuit, hence wave changing is accomplished by merely shifting the antenna lead along the antenna loading inductance. The radiation remains constant over a wide range of wave lengths without closed circuit tuning. Smooth disk gap experiments are also described.—*Proceedings Inst. of Radio. Eng.*, June, 1916.

Readers' Views and Comments

A College Course for the Study and Discussion of Engineering Periodicals

To the Editor of ELECTRICAL WORLD:

SIR:—At the University of Oklahoma we have found a very efficient method of applying engineering periodicals in classroom discussions. The course has been instituted to meet several conditions observed in American technical schools during the last four or five years.

These conditions, briefly stated, are as follows: There is a hiatus or gap to be filled between the textbook and the work in which the graduate finds himself after leaving college. (2) There has been noted a lack in breadth of view of many college graduates of recent years, due probably to too narrow or concentrated work in school. (3) There has been noted in the young graduate a weakness in the knowledge of relationships of different things engineering, and (4) the courses in English in most institutions have failed to provide a very good grasp of the essentials of technical composition.

The course mentioned is an attempt to take care of the weaknesses or deficiencies in training of the engineering college and to bridge the gap, in a way, between the text and the work. All magazines and proceedings of societies as they are delivered at the university, pass over the desk of the head of the department of electrical engineering, who uses characteristic marks on the different articles, indicating whether the article is to be read and discussed, or whether it is to be merely called to the attention of the student.

All students are required to give thorough study to all of the periodicals in a given list, and once a week, for a period of at least two hours, the instructional force of the department meets all the seniors in a general or detailed discussion of the matter which has appeared during the past week. In addition to the articles marked, any student is at liberty to bring up any article which he deems worthy of discussion, or upon which he may have some question. The nature of the discussion in most cases is rather general than in detail as regards purely scientific articles, for there is room in the general classes to consider more in detail any article which appears to need more extended discussion than can be given during this period.

The main benefits which have been noted from this course are a development of the viewpoint of the student, an intimate acquaintance of the student with the engineering periodicals, an added interest in the relation of engineering to the economic world in general, and an added grasp of the value and the opportunity of the engineer in present-day affairs.

Since the inauguration of this course, which has now been running successfully for three years, all of the graduating classes are unanimous in their verdict as to the benefit of the work—they view its value as being perhaps greater, for the time spent, than that of any other course in the curriculum. It has certainly developed a much greater usefulness for the engineering periodicals in this institution.

HAROLD V. BOZELL,
Director School of Electrical Engineering, University of Oklahoma.
Norman, Okla.

Minimizing Customers' Cash Deposits

To the Editor of ELECTRICAL WORLD:

SIR:—Several recent articles in your columns have dealt with the subject of customers' guarantee deposits, which so often prove troublesome to both company and customer. The general consensus of opinion now seems to be to abolish such deposits where it is safe to do so.

App. No.....
To.....
.....
Gentlemen:
We have received an application for service from.....
..... at.....
..... Applicant claims to have been a former customer of yours. Under these circumstances we would consider it a favor if you would fill in the information asked for on the reverse side of this card and return it to us in the inclosed stamped envelope. This information regarding applicant's past record will materially aid us in deciding whether or not to require a guarantee deposit.
Very truly yours,
.....
(Name)
....
(Date) (Address)
(Over)

CUSTOMER'S RECORD CARD—FRONT

A practice that has been used by some of the gas interests for considerable time with very satisfactory results is based on an exchange of credit information among the companies themselves by means of customers' record cards. Application for credit information is made by the utility receiving the application for service to the company from which the customer states that he had previously obtained service. The general plan has been found to give good results, and there seems to be no reason why similar success should not be obtained by central station companies in accomplishing the reduction of customers' guarantee deposits to a minimum.

Name of Applicant.....
Customer at.....
Customer for.....
From..... To.....
Was guarantee deposit required....
How much.....
Were bills paid promptly.....
Is final bill paid.....
How much is still due by applicant on old account.....
Did you require notices.....
Remarks: .....
.....
.....
.....
....
(Date) (Signed)
(Over)

CUSTOMER'S RECORD CARD—REVERSE SIDE

The use of these customers' record cards is advantageous in more ways than one. Not only does it minimize the annoyance and friction so intimately connected with the payment of customers' deposits, but the practice will tend to make customers more careful as to their records, and also encourage the public to look to the utility as a reference, when one is needed.

W. S. FLETCHER.
Chicago, Ill.

Vapor Pressure Regulation for Vapor Rectifier

To the Editor of ELECTRICAL WORLD:

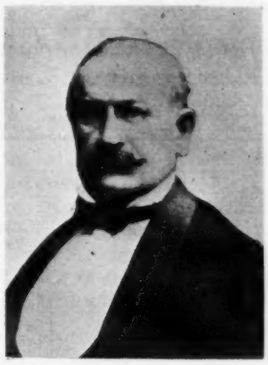
SIR:—Since the invention of the mercury arc, or vapor rectifier, by Dr. P. C. Hewitt no special vapor pressure (vacuum) regulation has been provided for the bulb or tank of a vapor rectifier. From investigations* dealing in principle with a close study of efficiency, bulb and transformer losses, anode current and voltage, wave form, vapor pressure, frequency and their dependency upon each other, the writer came to the conclusion that the vapor rectifier in the present form could not be used to the fullest advantage, regarding operation even if the best possible transformer and the best designed bulb, exhausted with the best possible care, are available.

It has been found by the writer that for a given primary voltage through changing of the vapor pressure (vacuum) or temperature in the bulb, the efficiency, bulb losses, anode current and voltage wave form (form factor) can be changed, or in other words through this regulation we can control for constant primary voltage, efficiency, bulb losses, anode current and voltage, and wave form (form factor).

The writer has, therefore, conceived the idea of providing a mercury vapor rectifier or vapor rectifier with a vapor pressure regulator to regulate the vapor to the best advantage which cannot be done when only a condensing chamber is used, although very distinguished engineers claim that a condensing chamber regulates the pressure. The writer will not attempt to explain this point in detail at this time. It is evident, however, since the vapor of the vapor rectifier is saturated, that it is just as well to speak of a temperature regulation since, according to thermodynamic laws, vapor pressure and temperature are in close relation. This principle of a regulation, allowing a broad application even in wireless telegraphy, is embodied in the U. S. patent No. 1,189,887.

WILLIAM TSCHUDY, PH.D.
Wilkinsburg, Pa.

*Experimentelle Untersuchungen am Quecksilberdampf Gleichrichter. Thesis at Technical University, Zürich, 1912. See also ELECTRICAL WORLD, June 17, 1916.



DR. C. O. MAILLOUX

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Dr. C. O. Mailloux, who sailed for France on Aug. 26 to study electrical conditions in the French Republic, as a member of the American Industrial Commission, is a past-president of the United States national committee of the International Electrotechnical Commission, and of the American Institute of Electrical Engineers. Dr. Mailloux was one of the very first to take up electrical engineering as a profession in this country. He attracted wide attention in 1882 with his series of articles on dynamo-electric machines, which were among the first published in America. In 1883 he served as the first editor of the ELECTRICAL WORLD, and in the same year began his present consulting engineering practice which has since covered activities in this country and abroad in many important branches of the art. It was also in 1883 that he signed the call for the organization of the A. I. E. E., becoming one of its charter members, and since serving it in many official capacities, leading up to his term as president in 1912-1913. In 1900 Dr. Mailloux served as the delegate of the Institute to the International Electrical Congress at Paris, and was instrumental in obtaining the adoption by the Congress of the "maxwell" and the "gauss," units which the Institute had proposed. In 1906, while abroad, he was asked to serve as the delegate of the Institute to London, and took an important part in the formation of the International Electrotechnical Commission. In 1908 Dr. Mailloux represented the Institute at Marseilles, France, and in 1911 he was the American member of the conference at Turin, Italy.

M. E. Bates has resigned as city electrician of Kansas City, Mo., and Charles M. Caldwell has been appointed. Mr. Caldwell formerly served a term as city electrician.

C. B. Semple, formerly manager of the Chicago office of the Duplex Metals Company, and recently with the Hazard Manufacturing Company, has resigned from the latter company to become manager of the copper-clad steel department in the Chicago office of the Steel Sales Corporation.

N. C. Draper, manager of the Sioux Falls, S. D., division of the Northern States Power Company, was elected vice-president of the South Dakota Electric Power Association at its annual meeting, Aug. 8.

Llewllyn Evans has been appointed manager of the Tacoma, Wash., municipal electric light plant, succeeding B. W. Collins, who recently resigned. Mr. Evans is a member of the firm of the Industrial Engineering Company, 725 Commerce Street, Tacoma.

John F. Vaughan, who has opened a consulting engineering office at 185 Devonshire Street, Boston, Mass., had been associated with the Stone & Webster Engineering Corporation of Boston for about fifteen years, giving special attention to electrical transmission and hydraulic power problems. Prior to his connection with Stone & Webster Mr. Vaughan was associated with the late Col. N. H. Heft in the pioneer electrification work of the New York, New Haven & Hartford Railroad on the Nantasket Beach and other lines. He is the inventor of the Vaughan flowmeter and has served as chairman of the hydraulic branch of the N. E. L. A. committee on prime movers. Mr. Vaughan has been retained by the banking house of Estabrook & Company, Boston, in connection with the re-development of a 20,000-kw. hydroelectric power installation now under way at Sault Ste. Marie, Ont.

W. B. Voth, who recently resigned as chief engineer and purchasing agent of the Empire United Railways, Inc., of Syracuse, N. Y., came to Syracuse two years ago from the general superintendency of the electric railway and lighting properties at Sheboygan, Wis. Mr. Voth is a native of Milwaukee and was graduated from the University of Wisconsin in 1897. After designing, constructing and operating several small hydroelectric plants in his native state, he was appointed resident engineer at Sheboygan in 1904 during the building of a steam-power station and the reconstruction of the local commercial and street lighting system. After finishing the construction work, Mr. Voth remained to operate the plant as general superintendent. At the same time, he acted as consulting engineer for the Greensboro, N. C., company controlled by the same interests, resigning, however, in 1914 to become chief engineer and purchasing agent for the Empire United Railways, the Auburn & Syracuse Electric Railroad and the Syracuse & South Bay Electric Railroad, in which position he had charge of about 340 miles of track, overhead and transmission lines, including fifteen substations.

J. F. ROCHE

J. F. Roche, who was recently appointed manager of the Butte district of the Montana Power Company, is a pioneer in the development of the use of electric cooking by the general public, and at Billings, Mont., where he was formerly manager for the Montana Power Company, had attained, even four years ago, a local development including more than 400 electric cooking customers in a community of 10,000. Mr. Roche first entered the employ of the electric company at Billings in 1900, and in 1908 was appointed secretary and treasurer of the company. Later he was appointed manager of the Billings & Eastern Montana Power Company which served besides Billings, the towns of Laurel, Park City, Columbus, Big Timber, Joliet and Fromberg, Mont. He continued in charge of this entire Billings district of the Montana Power Company until March of this year, when he was promoted to be district manager for Butte.

Lawrence W. Jackson, who has been local auditor for the Alabama Power Company at Anniston, Ala., for several years, has been appointed acting manager in charge of the local property, succeeding A. L. Kenyon, who resigned to accept a position as manager at Columbia, S. C.

Herbert A. Wagner, president of the National Electric Light Association and president of the Consolidated Gas, Electric Light & Power Company of Baltimore, Md., was elected an honorary member of the International Association of Municipal Electricians during its convention at Baltimore, from Aug. 22 to 25, when Mr. Wagner addressed the association on the subject of the relations of the N. E. L. A. and the municipal electricians' organization.

Obituary

Henry C. Burkett, who died at Saranac Lake, N. Y., on Aug. 27, was formerly superintendent of the Pulaski (N. Y.) Electric Light Company. About two years ago his health began to fail. Recovering, he came home again, but returned last spring. Mr. Burkett was born in Redfield thirty-three years ago.

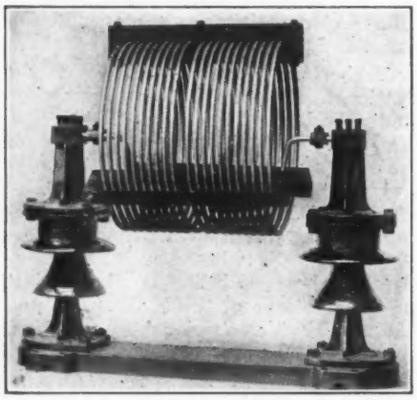
NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Choke Coils

In the protection of electrical apparatus against lightning a good choke coil is almost as important as a good arrester. The high frequency or steep wave front of lightning and other surges builds up an excessive voltage between the end turns of electrical apparatus connected to the line as well as a high voltage to ground. A choke coil connected ahead of the apparatus will take the place of these end turns and the strains will thus occur across turns whose insulation is especially designed to stand them. Even if the insulation of some of these turns does break down no harm will result, as in the case of a transformer, since the air insulator is self-healing and the coils have no short-circuit energy to maintain an arc between turns. A good choke coil must have sufficient inductance to choke back the greater part of each high-voltage surge, and also high insulation to ground. It must also have high mechanical strength so that it can support its own weight without sagging and can resist the stresses due to line short circuits when they occur.

The Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has recently added to its line of 15-in. choke coils a new line of smaller coils 9-in. in diameter. Both sizes are listed for outdoor or indoor mounting for pressures up to 130,000 volts, with a separate line of 9-in. coils for indoor mounting with ratings up to 49,000 volts. The coils are made up of a helix of aluminum rod in the 200-amp. and 400-amp. capacities and of copper in capacities of 600-amp. and above. A



CHOKE COIL WITH EACH TURN BRACED

typical feature of their design is the thorough bracing of each turn of the coils, which gives them all the rigidity necessary to withstand the stresses due to line short circuits. This bracing of the turns makes it unnecessary to reduce the diameter of the center of the coil and thus sacrifice much of the inductance in order to prevent sagging. Another notable feature is the construction of the insulator supports which (except in the case of the 9-in. outdoor coils rated below 49,000 volts) permits inverting the insulators so that the coils can be mounted either upright or suspended from the ceiling. In the case of coils for very high voltages where built-up insulator columns are used, the porcelain units are bolted together and it is therefore easy to replace broken porcelains or add more units when desired.

The 9-in. coils, now offered for the first time, have as much inductance as is ordinarily used, and can be applied in a great many installations where lightning conditions are not abnormally severe and where the apparatus to be protected has good insulation. The 15-in. coils have about five to seven times the inductance of the 9-in. coils and afford correspondingly greater protection. They are the largest helical coils now said to be on the market for lightning protection and are designed for use wherever lightning conditions are very severe or where the apparatus is not new and rugged.

Soldering Paste

A soldering flux in paste form for use in fluxing solder on all kinds of metal except aluminum is being placed on the market by the Burney Battery & Manufacturing Company, North East, Pa. It is more economical than the old acid flux, it is claimed; will not spill, stays where it is put, and makes the solder flow more freely and quickly. The material is self-adhesive, non-corrosive and free from acids. It is applied with a splint or brush. The paste is being used by incandescent lamp and arc-lamp manufacturers, dynamo builders, armature winders, etc.

An "Always Vertical" Suspension Fixture

The Central Electric Company of Chicago is manufacturing a special suspension fixture for factory lighting units which not only permits the fixture to hang always vertical, but gives it considerable protection against breakage when struck by moving objects. This is known as "the always-vertical suspension" and consists of a liberal-sized cast-iron canopy with screw holes to fit a standard 4-in. outlet box. The canopy incloses a ball-and-socket joint which permits the fixture to swing through an angle of 25 deg. in any direction should it be struck by a moving object, but the arrangement is such, however, that it cannot be turned in a horizontal plane and the fixture wires twisted off.

It frequently happens in factory buildings, especially those of concrete construction, that outlet boxes are not

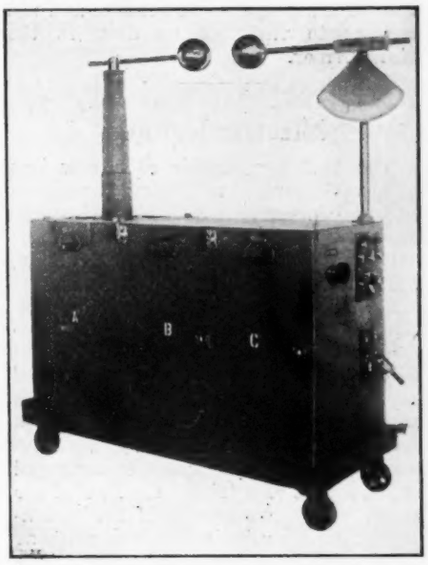
FIXTURE SUSPENSION WITH BALL-AND-SOCKET JOINT

set in perfectly straight and it is difficult to make fixtures suspended from them hang perpendicular. With this flexible suspension, the stem of the fixture, it is claimed, will always hang vertical, thus improving the appearance of the installation and bringing the lighting units and lamps into their most efficient position. The use of the fitting makes a stud, crow foot, hook and box cover unnecessary, and the market price is so little in excess of the parts that it replaces, that it is claimed it readily pays for itself in the saving of labor in installing. The device is patented and has been approved by the National Board of Fire Underwriters.

High-Frequency Testing Transformer

With the immense generating units now being installed in the larger cities, the problem of providing switches and busbar supports of suitable design and certain high insulation value becomes more and more important. Keeping abreast with these requirements, the General Devices & Fittings Company of Chicago has installed a high-frequency transformer set in its plant with which it can subject all its completed devices for high voltage and heavy load, upon which it specializes, to the severe test of high voltage and high frequency. Heretofore all porcelain devices have received a high-frequency test as well as mechanical tests

at the plant of the manufacturer, and the assembled switch, or busbar support, etc., has received a 60-cycle high-voltage test at the Chicago company's plant upon its completion. The greatly increased requirements upon the bus structure and switches, however, to-



HIGH-FREQUENCY TRANSFORMER FOR TESTING HIGH-VOLTAGE SWITCHES AND BUSBAR SUPPORTS

gether with the demand on the part of certain of the large companies for both 60-cycle and high-frequency tests upon the completed piece, has led the company to install a new high-frequency set to supplement its 60-cycle testing equipment, which is also being replaced with a larger and more powerful set.

The high-frequency test set was furnished by the American Transformer Company and consists of an oscillation transformer suspended horizontally in an oil-filled wooden receptacle in the top of the cabinet. The condensers are located directly below this with the rotary spark gap in front of them. The 60-cycle step-up transformer and primary reactance are in the bottom of the cabinet. Sixty-cycle, 220-volt energy is supplied to this transformer from a 3-kw., 220-volt generator, belt driven off the line shafting in the plant, the fields being excited with direct current from the Commonwealth Edison Company mains. This means of supplying the 60-cycle energy was used to avoid disturbances which would be likely on the Edison lines due to the high-frequency transformer operations if the machine were supplied from the Edison alternating-current service. The transformer has a capacity of 1 kva. and will deliver up to 150,000 volts at 200,000 cycles per second frequency. All pieces are tested for four and a half to five times their rated working pressure, testing first the porcelains as they are received from the manufacturer and later the assembled device. The test set is in a room which may be darkened for observing more accurately the effect of different shapes of porcelain on the nature of flash-over or breakdown, for the development and study of new designs.

Electrical Attachment for Oil Lamps

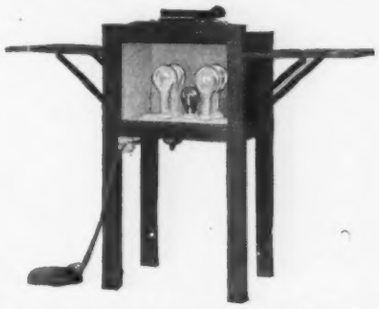
An interesting and rather unusual device is the No. 5403 oil-lamp attachment which is shown herewith mounted in a Rochester burner and which is adapted for use with any type of oil lamp having a common burner either of the flat wick or central burner type. As shown, the attachment can be sprung down in the same manner as the lamp chimney and current taken from any near-by socket or receptacle, thus converting the oil lamp to an electric lamp. If so desired, the lamp may be immediately converted back for use with oil as the attachment of the device does not interfere in any way, it is stated, nor

OIL-LAMP ATTACHMENT

are tools required to attach or detach. It is provided with 7 ft. of cord and a new style porcelain attachment plug which was recently described in these columns. The device has been brought out by Harvey Hubbell, Inc., Bridgeport, Conn.

Electric Photograph Printer

The "Crown" photograph printer shown herewith has been developed by the Folmer & Schwing Division of the Eastman Kodak Company, Rochester, N. Y., for both professional and amateur use. A feature of the device is an automatic switch which is operated only when full pressure is placed on the pad. The pressure pad is placed in position by a hand lever which controls the automatic switch, the light being turned on only when full pressure is exerted on the pad. The light is turned off before pressure on the pad is released, thus avoiding any blurring in the prints and assuring absolute contact irrespective of size or thickness of paper or negative. A locking device is provided which relieves the operator of the necessity of maintaining pressure on the lever during the exposing period. With a slight grip on the release catch, the lever can be freed. A locking device is also provided, permitting the white light to be turned on and the pressure pad elevated to permit accurate adjustment of masks or vignettes. The printer is being made in two sizes, 8 in. by 10 in., and 11 in. by 14 in. In the light box of the smaller printer are



ELECTRICALLY ILLUMINATED PHOTOGRAPH PRINTER

one ruby and four clear incandescent lamps, and in the larger one there are one ruby and six clear incandescent lamps. The printers are designed to take 100-watt gas-filled lamps. The smaller printer is 30 in. high and occupies a space 15.5 in. by 17.5 in. The larger one is 30 in. high and takes up a space of 20 in. by 22.5 in.

Reflector for Direct Lighting of Large Interiors

A reflector of the deep-bowl type designed especially for use with nitrogen-filled lamps and for direct lighting of large interiors has just been placed on the market by the National X-ray Reflector Company, 235 West Jackson Boulevard, Chicago, Ill. This No. 580 reflector, as it is called, is provided with an adjustable holder which is designed to fit any mogul socket. The reflectors are placed at the ceiling, thus avoiding drop cords and reducing lamp breakage, it is declared, as well as

DEEP-BOWL REFLECTOR

economizing the time of workers who do not have to fix their individual light. The No. 580 reflector unit is designed especially for 300-watt, 400-watt and 500-watt lamps. It is 11.875 in. in diameter, 9.375 in. high and weighs 4.5 lb.

Electric Radiator

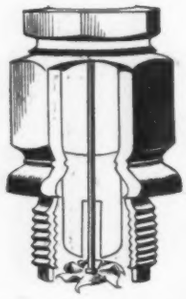
In the accompanying illustration is shown an attractively designed radiator. As shown in the illustration the radiator is equipped with a lamp, which is operated by a chain so that the light

ORNAMENTAL ELECTRIC RADIATOR WITH LAMP ATTACHED

can be turned on or off independently of the heater. The radiator is beautifully nickel-plated, and is provided with a handle at the top so that it is readily portable. When in operation the heater gives off a pleasant glow and is an excellent substitute for the open grate. The device can be connected to any lamp socket, and according to assertions of the manufacturer, the Pelouze Manufacturing Company, 232 East Ohio Street, Chicago, Ill., is very efficient.

Spark Plug with Rotating Electrode

A radical departure from the usual type of automobile spark plug is shown in the "Fan-Fire" plug illustrated, for which the designer claims a number of practical advantages. This plug, as shown, has a turbine fan loosely mounted on the center rod, the compression and explosion of the engine causing the fan to rotate rapidly. From the extremity of the fan blades sparks are delivered to the bushing. This improvement, it is declared, not only provides a larger sparking area,



SPARK PLUG WITH TURBINE-WHEEL SPARKING ELECTRODE

but insures certain ignition. The plug is said to be to a very large extent self-cleaning, as the fan automatically throws off soot and oil deposits. The plug is manufactured by the Fan-Fire Spark Plug Company of Yonkers, N. Y.

Portable Meter-Testing Instrument

A Type F "phantom load," as it is called, designed particularly for use in testing alternating-current watt-hour meters by the rotating standard test meter method, has been developed by The States Company, 19 New Park Avenue, Hartford, Conn., and is shown herewith. When using a rotating standard test meter, it is stated, it is desirable to have a portable instrument which is not only small, light, easily adjustable, non-inductive and economical of energy, but which also has closely fixed load steps so as to eliminate time in making adjustments. The testing current is taken from the low-voltage secondary of the transformer which is mounted in a box 6.25 in. square. The primary is wound in two coils which are connected to a terminal plug connection block. The plug has three projections and automatically connects the primary coils in multiple or series, according as it is inserted in the apertures marked 110 or those

INTERIOR VIEW OF METER-TESTING DEVICE

marked 220. Use is made of secondary pressures of 5 volts and 10 volts. The load current up to and including 5 amp. is taken from the 10-volt winding. For loads above 5 amp., the 5-volt winding is used. The various load steps are fixed by means of resistors which are connected in the transformer secondary and are mounted on an insulating base of high heat endurance and are protected by a ventilated cage mounted on one end of the box. The resistors are of approximately zero temperature coefficient. The adjustment of the load is accomplished by means of the rotating switch on top of the box. The top and rotating switch members are of molded bakelite. On the under side of the rotating switch is a metal sector which engages spring contacts attached to the under side of the cover by screws and molded inserts. Each spring contact is connected to a resistor and as the sector is rotated, the resistors are connected in circuit cumulatively. On the top of the cover in a ring outside of the periphery of the rotating switch are numbers indicating the loads for the different positions of the rotating switch. The device is being made with ratings of 15 amp. for 60 cycles; 15 amp. for 25 cycles; 35 amp. for 60 cycles; 35 amp. for 25 cycles; 75 amp. for 60 cycles, and 75 amp. for 25 cycles, the respective weights being 5.5 lb., 7 lb., 7 lb., 11 lb., and 15 lb. Since the load steps are adjusted at each point with a given length and size of leads, the steps are said to be reliable and not subject to variation by drop in the transformer.

Electric Ranges

The first two models of a new line of electric ranges are being announced by the Globe Stove & Range Company of Kokomo, Ind. These stoves, it is said, will be different in construction, finish and price from the manufacturers' former line. The ranges are presented by the manufacturer as absolutely plain and serviceable stoves, built without frills, and designed for rugged service. The top surface is made of cast iron. It may be finished either in dead black or dull black. On this service three heating units will be arranged at the apices of a triangle. Two of the units, which are arranged for operation at three temperatures, are rated at 1300 watts, and the third, which is a single-temperature unit, is rated at 1000 watts.

A large oven is provided. In one model, as illustrated herewith, the oven is placed directly below the cooking surface of the stove. The other model will be made with what is known as a side elevated oven. In both models the oven will measure 13 in. by 18 in. by 18 in., and will contain heating units of the open-coil type in the top and the bottom.

The manufacturers believe that this

RANGE WITH THREE TOP BURNERS

is the sort of a range which central stations are demanding, and state that in attempting to cater to all tastes they have made arrangements to provide the ranges with either a black or a nickel finish.

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

SANITARY DISTRICT LIGHTING OF CHICAGO PARKS

South Park Commissioners Contract for Electricity for that Purpose for 7.5 Mills per Kilowatt-Hour—Details of Agreement

The South Park Commissioners of Chicago have contracted with the Sanitary District for electric energy for light and power purposes in the various parks and boulevards under their control for a period of five years, beginning April 27, 1916, and with the right to extend the agreement for a further period not to exceed fifteen years. A flat rate of 0.75 cent per kilowatt-hour for energy consumed is to be charged. The total consumption of energy in all the parks and boulevards and buildings included in the contract will range from 4,000,000 kw.-hr. per year at the present time to 12,000,000 kw.-hr. in the future, with a corresponding peak load ranging from 700 kw. at present to 2500 kw. in the future, and should the generating capacity of the power plant of the Sanitary District be sufficiently increased, the peak load will be increased to a maximum of 3500 kw., or as much as the increased capacity of the power plant will permit.

The district supplies energy to transformer substations installed by the commissioners in Washington, Marquette and Grant Park, and in the Hiram Kelly Branch Library, and in not more than two other parks or boulevards under the jurisdiction of the South Park Commissioners. Energy is supplied to these transformers at 12,000 volts and stepped down to 2300 volts, and the transmission lines leading to these substations, and the protective devices are to be maintained by the Sanitary District. The transformers, switchboard equipment, materials and appliances in the substations are to be maintained by the commissioners. The Sanitary District agrees to maintain its transmission voltage within 5 per cent of 12,000 volts at the substations of the commissioners.

The meters for recording energy consumption are located on the secondary side of the transformers. The park commissioners have reserved the right at the expiration of any year of the life of the contract to change the unit of price for energy delivered from a kilowatt-hour basis to a horsepower-year basis. In this event the price of energy is to be $26.40 per horsepower, furnished during one year of days of twenty-four hours each, and $15 per horsepower during one year of days of twelve hours each, it being understood that energy furnished for night arc lighting only, whether for more or less than twelve hours, shall be reckoned as furnished for a day of twelve hours' duration, and energy furnished for such time will be billed on the basis of the twelve-hour, $15 rate. With the horsepower-year basis of pay for energy, the commissioners have also agreed to pay in addition to the above rate per horsepower per annum a sum equal to 5 per cent interest and 3 per cent depreciation on the cost of the Sanitary District's transmission line between the district's terminal station and the various parks, and also pay for an added horsepower consumption for transmission losses on these lines an amount not to exceed 5 per cent.

The Sanitary District also agrees in the contract that if a contract is entered into with any other consumer for the delivery of energy at a rate lower than that given the commissioners, reckoned on either the kilowatt-hour or horsepower-year basis, it will at once reduce the rate charged for energy to the commissioners to the lowest price for which energy is supplied to any other consumer under similar conditions.

The South Park Commissioners will maintain their steam-turbine plant in the Washington Park powerhouse in working condition during the period of the contract, and they agree to operate this plant upon the request of the district for the generation of electrical energy between the hours of 4 p. m. and 6.30 p. m. during the months of November, December, January and February, but the energy so generated is to be used for the purpose only of assisting the district in meeting the peak-load demands on the system; and also at other times than during the above months if requested by the district for the purpose of supplying energy during the temporary inability of the district to supply electricity from its own plants on account of failure in transmission lines or damage or accidents to its machinery. The district agrees, however, that it will not require the operation of the commissioners' plant for more than one period of eight consecutive hours in any twenty-four hours, but within this period the district may cause the plant to be shut down and started again any reasonable number of times. Also the commissioners are not required to maintain a steam operating force for any period other than for eight hours in any day of twenty-four hours.

When necessary to start up the generating equipment of the Washington Park plant in any month, there shall be a minimum charge of $50 for labor, and when started the machinery may be operated for eight hours in each of two consecutive days, without further charge for labor. For the next three days of operation, whether consecutive or not, the labor charge will be $20 a day, and for the next three days, whether consecutive or not, $15 a day, and for all days thereafter $10 a day. The maximum labor charge for the operation of the plant is not to exceed $287.50 in any month. In addition to the labor charge, the Sanitary District agrees to pay for all fuel and other supplies consumed by the commissioners in the operation of their plant for supplying standby energy in excess of the amount required when the plant is operated for heating purposes only.

If the Sanitary District should fail to supply energy in such amounts as may be required, exclusive of that generated at the Washington Park plant, at any of the above-mentioned substations for more than forty-eight hours in any one month, or if there should be more than twelve interruptions aggregating seventy-two hours in any year, at any of these substations, the commissioners may declare the contract forfeited.

The agreement provides that at the expiration of the contract in five years, the commissioners may dispose of the steam turbine plant in Washington Park, its removal not in any manner to impair the rights of the commissioners to a supply of energy from the Sanitary District as provided by the contract.

Shields Bill Goes Over

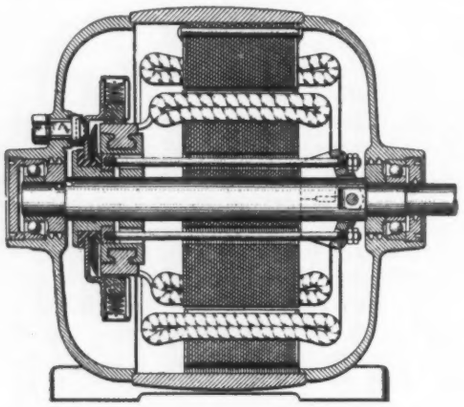
Senate and House conferees of the Shields water-power bill decided last week there was no hope of coming to an agreement on the points at issue between the two Houses of Congress and the legislation will go over until the next session.

Conservationists have fought the bill bitterly, claiming that it gives away to the private water-power companies natural rights of immense value. The bill passed the Senate on March 8, 1916, but when it reached the House it was almost entirely rewritten, all but the enacting clause being stricken out. The resulting bill is known as the Adamson bill.

The Shields bill deals with the development of water power on navigable streams. A synopsis and comparison of the different water-power bills before Congress will be found on page 1398 of the ELECTRICAL WORLD for June 17 last.

A Repulsion-Induction Motor

A new type of alternating-current motor has been invented by Alfred P. Welch, (Patent No. 1,194,103), and assigned to the General Electric Company, in which after the motor has started the brushes, which make the repulsion motor connection, are caused to revolve with the rotor of the motor. These brushes thus provide a revolving short-circuiting connection to the winding of the rotor in addition to that furnished by the usual switch for short-circuiting the commutator, but do not add to the friction of the machine, nor do they



NEW REPULSION-INDUCTION MOTOR

wear away while the machine is operating at normal speed. As the rotor speeds up, weights tend by centrifugal action to cause a switch to move into contact with the commutator, thereby short-circuiting it and at the same time lock the brush holders and brushes in such a way as to revolve them with the rotor. The motor thereby runs on the induction principle.

Removing Iron Rust Electrolytically

A rather interesting method for removing oxid or rust from steel or iron surfaces is disclosed by Pascal Marino of London, England, in Patent No. 1,195,704. According to the invention, the article is employed as a cathode in an aqueous bath either of phosphoric acid or of a phosphoric acid compound to which phosphoric acid has been added. The electrolyte is made either by a solution of ten parts of phosphoric acid in ninety parts of water or by an aqueous solution of a phosphoric acid compound to which has been added 10 per cent of phosphoric acid, *e.g.*, to a 10 per cent aqueous solution of sodium phosphate is added 10 per cent of concentrated phosphoric acid.

Conductive plates of carbonaceous material or lead are placed in the electrolyte and serve as anodes. The articles treated when immersed in the bath serve as cathodes. The effect of the electric current is to remove the layer of oxid from the article under treatment, with the result that its surface becomes quite clean and ready for any subsequent technical or electrochemical operation.

Electrical Development Society Increases Central Station Membership

As an indication of the increased interest evinced by central stations in the work of the Society for Electrical Development, it is stated that recently 141 central stations have become members. The increased membership is representative of all parts of the country, and includes as well the subsidiary companies of four important holding companies.

The society is doing good work for the lighting companies, especially as regards electric range campaigns and special advertising services. It now has on file complete records of rates in 3250 communities which quote a 5-cent rate or under for heating and cooking. Of this number about 70 per cent are 4-cent rates and under, and 30 per cent are 3-cent rates and under.

Public Service Commission News

Illinois Commission

An interesting case which was before the commission recently was the complaint of Messrs. Risser and Rollins, of Paxton, relative to alleged unfair discrimination in the matter of electric heating and cooking rates of the Central Illinois Utilities Company. The schedule of rates of the company provides for rates for power and lighting service, and also for electric cooking service. The complainants in this case are power users, and receive electric service under the regular power schedules of the company. They felt that the rates for heating and cooking service were lower than those provided for power service, and alleged that unfair discriminations resulted.

At the hearing before the commission, it appeared that the service of the complainants was of such a nature that it required unusual facilities on the part of the company, since the complainants were located at some little distance from the regular distribution circuits of the company, and also that the hours at which the complainants required service were very largely coincident with the peak load on the company's station. It also appeared that the characteristics of the heating and cooking service in Paxton were such that this load did not come at the time of the station's heaviest load, and that the service could not be rendered in most cases from distribution circuits which were already in service. Largely for these reasons, the commission found that in so far as the particular complaint under consideration was concerned, no unfair discrimination exists, but ordered the company to file a schedule of rates for off-peak power service, which should give advantage to such a class of service, commensurate with the reduced cost at which the company is able to render it.

While this case is of interest, it should not be regarded as a precedent, since the power service rendered in this particular case seemed to have rather unusual characteristics.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Last of Indiana Counties Enjoys Electric Lights.—When the electric current was turned on in Nashville, Brown County, on Aug. 21 for the first time, the last of the ninety-two counties of Indiana was supplied with electric light.

Wireless Messages Between Aeroplanes.—Captain C. C. Culver, in an army aeroplane, received on Sept 2 a message which was transmitted several miles by Lieutenant W. A. Robertson, who was in another aeroplane. The message, it is reported, was received distinctly by Captain Culver. The machines according to reports were three miles apart and flying at an altitude of one mile.

Electric Baking Increases Demand 8000 Loaves.—The first data on the effect of electric bread baking in the New Vienna Baking Company at Salt Lake City, described in the ELECTRICAL WORLD for Aug. 26, shows an increase in demand of 8000 loaves in one day. Prior to the time when electrically-baked bread was advertised the company's daily sale was 10,000 loaves, and on the day following the advertisement the demand increased to 18,000 loaves.

Ninety-two Labor Laws Passed During Legislative Year.—Ninety-two labor laws have been passed by Congress and state legislatures during the last legislative year, according to a survey which was made public by the American Association for Labor Legislation, on the eve of Labor Day. "The reorganization and unification of the administration of labor laws," the association says in its summary of labor legislation, in the various states, "continues, the most noteworthy changes this year being in Maryland and New Jersey, where steps were taken toward consolidation of factory inspection and workmen's compensation administration."

Bill to Give Kansas Commission Power Over Receivers.—Governor Capper of Kansas and W. F. Benson, bank commissioner, have announced that they will seek from the next Legislature a bill giving the Public Utilities Commission power over utilities similar to the power exercised by the banking department over banks, as to receivers. The governor suggests that the Public Utilities Commission should appoint a man to run a utility that is in difficulties, under its supervision, and that only as a last resort should the courts be appealed to when the utility is in hard straits financially. The complaint of both the Governor and the bank commissioner is that too often men unfamiliar with the technical operations of utilities are put in charge as receivers.

West Virginia Requires 660-Watt Sockets.—After due consideration of the tendency toward increasing use of electrical appliances of all kinds, the electrical inspection bureau of West Virginia has required the use of 660-watt sockets or 660-watt receptacles in all residences, flats, millinery establishments, meat shops and grocery stores.

Canadian Niagara Power-House Zone Embargo in Effect.—The Victoria Park Commission of Niagara Falls, Ont., ordered an embargo on the Canadian power-house zone on the upper river to go into effect on Sept. 5. The gates of the barb wire entanglements which have been erected will then be closed until the end of the war. Military authorities have increased the guard in the immediate vicinity of the power-house zone and no tourists are allowed within 2000 ft. of the Canadian generating plants.

Standards for Electric Service.—Circular No. 56 of the Bureau of Standards discusses the most important factors constituting and promoting safe and adequate electric service, the circular being based on a careful study of the experience of operating companies and regulating bodies, both state and municipal. The circular contains, first, rules and recommendations for the regulation of electric service companies by state commissions; second, three different ordinances suitable for adoption by towns and cities in states not having regulation by commissions (the first for towns and small cities, the second for cities generally and the third for large cities having an electrical inspector); and third, specifications for the approval types of electric meters by commissions.

Legislature Has No Right to Nullify Contract Between City and Private Corporation.—Holding that the "Seventy-five Cent Gas Law," passed in 1905, regulating the rate to be charged the city for street lighting purposes was unconstitutional in its application, Justice Crane in the Supreme Court, Brooklyn, N. Y., sustained a demurrer of the Kings County Lighting Company, which is seeking to recover $110,979 from the city for gas supplied in the Thirtieth Ward of Brooklyn between Oct. 1, 1914, and June 30, 1915. The company based its case on a contract made between it and the Town of New Utrecht in 1879, by which gas was to be supplied at the rate of 95 cents a thousand cubic feet. In its answer to the original complaint the city held that the so-called "seventy-five cent gas law" of 1905 established the rate of 75 cents a thousand cubic feet for city street lighting, and that the law in effect nullified the contract which had been entered into between the Town of New Utrecht and the corporation. Justice Crane, in his opinion, said the Legislature had no right to nullify a contract made by the city and a private corporation. He said he did not question the right of the Legislature to regulate the price of gas to consumers, but held that the application of the law in this instance was illegal.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Vermont Electrical Association.—Plans have been made to hold the annual outing of the association at Bluff Point on Sept. 14.

Institute of Radio Engineers.—A meeting of the Institute of Radio Engineers was held on Sept. 6, in New York City. There were presented two brief papers by Leonard Fuller on "A Brief Technical Description of the New San Diego, Pearl Harbor and Cavite High-Power Naval Radio Stations" and "A Few Experiments with Ground Antennas." In addition, there was presented a paper by Prof. Charles A. Culver on "Notes on Radiation from Horizontal Antennas."

Associated Manufacturers of Electrical Supplies.—The fan-motor section of the Associated Manufacturers of Electrical Supplies held a meeting at Niagara Falls, Ont., on Aug. 21. John H. Barker of the Diehl Manufacturing Company is the chairman of this section. There was a full attendance of the members. Many matters of importance were discussed and plans laid for many activities. The line material section held a meeting at the Hotel Biltmore, New York City, on Sept. 7, 8 and 9. A. L. Wilkinson is chairman.

Colorado Convention Program.—The following tentative program has been arranged for the convention of the Colorado Electric Light, Power and Railway Association at Glenwood Springs on Sept. 21, 22, 23: "The Electric Range Game," by H. L. Titus; "The New Operating Rules," by F. J. Rankin; "Uniform System of Reports and Local Reports," by W. L. Sterne; "Tell the Public What You're Doing," by F. P. Weed; "Selling Securities to Consumers," by W. F. Raber; "Utility Regulations," by M. H. Aylesworth; question box session; "How You Can Get More Lamps Into Use," by S. E. Doane; "The Society for Electrical Development," by H. W. Alexander; report of special committee on depreciation, by H. U. Wallace; "Pertinent Remarks on Depreciation and Your Annual Report," by F. W. Herbert; "Sensible Rates for Lighting, Cooking and Power," by L. P. Hammond; and report of special committee on more equitable assessment of dues, by W. F. Raber.

Cleveland Electrical League Dedicates New Quarters.—Members of the Electrical League of Cleveland met in the ballroom of the Hotel Statler on Thursday of this week for a luncheon meeting, preliminary to the dedication exercises in the afternoon of the league's new clubrooms on the roof of the hotel. In the evening, an entertainment and reception were held in the new rooms to which ladies were invited.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

CO-OPERATION AMONG MANUFACTURERS

What the Associated Manufacturers of Electrical Supplies Have Accomplished in the Year and a Half Since Their Organization

There are at present time some 250 representatives of electrical manufacturers who as members of the Associated Manufacturers of Electrical Supplies are promoting co-operation among electrical manufacturers. This association, which was formed in March, 1915, has as its aim, as set forth in the first clause of its constitution, "to advance and protect the interests of the manufacturers of electrical supplies and of the manufacturers of materials entering into electrical construction, in manufacturing, engineering, safety and other problems, to promote the standardization of electrical material, to collect and disseminate information and to promote co-operation among the members."

Owing to the diversity of electrical manufacture, it was necessary to form sections, and in the organization of sections it was found desirable to sub-divide the members into committees, thus enabling each member to take part in the particular work in which he is especially interested. As a part of the co-operation of the members, the following has been approved by the board of governors, as activities which the sections may properly consider, and to these, it is understood, others will be added from time to time as occasion requires: (1) Standardization and manufacturing problems—such as manufacturing methods, type and quality of product, etc. (2) Standardization and manufacturing problems in conjunction with the Underwriters' Laboratories. (3) Packing and shipping problems—such as the size of packages, methods of packing and marking, etc. (4) Collection and compilation of statistics for the individual use of the members of the sections as to any one or more of the following subjects: (a) The condition of the market for raw materials used by members. (b) The current and probable future demand for the product of members. (c) The output of all plants manufacturing articles of like or similar character to those manufactured by members without disclosing the output of individual plants. (d) Members' selling methods—such as through jobbers, manufacturers' agents, directly to trade, etc. (e) Relationship between members and their sales representatives—such as basis of compensation, methods of instruction, etc. (f) Members' credit terms and collection methods. (g) Members' policies as to return goods and credit allowances. (5) Cost accounting methods and recommendation to the members for their use of such systems as may seem best adapted to their needs. (6) Freight questions and united action, if desirable, for the purpose of obtaining reductions in rates. (7) Insurance questions and united action, if desirable, for the purpose of obtaining reduction in rates. (8) Forms of specifications and suggestions to members for their use of a standard form. (9) Guarantees made by members in connection with the sale of their products, and suggestions to members of what guarantees, if any, should be given. (10) Relationship, actual and possible, of the separate branches of the industry to each other, including central stations, manufacturers, jobbers, contractors, etc.

In every section, work along one or more of the above suggested lines has been undertaken and according to the latest reports is progressing with the most satisfactory results. There are now thirteen sections of the association, each section subdivided in committees to meet the requirements of every member of each particular section. These sections, which are fully organized, are as follows: Fan motor, fuse, interior conduit, knife switch, lamp receptacle and socket, lighting fixture, line material, molded or formed insulation, outlet box, panelboard and switchboard, porcelain, snap switch, and wire and cable.

To co-ordinate the work of the Electrical Manufacturers' Club the Electric Power Club and the Associated Manufacturers of Electrical Supplies, and to act on questions of common interest to the three, the Electrical Manufacturers' Council was organized. Each of the national bodies is represented in the council by four members. At the present time the council is actively engaged in the consideration of a uniform cost accounting system for the electrical industry, and other matters of importance and of general interest to the members of the three bodies.

TREMENDOUS TURBINE BUSINESS

Volume of Orders Handled Since Beginning of Year in Excess of 2,000,000 Kw. of Turbine Rating

Since the beginning of 1916 the demand for steam turbines has far outstripped anything in the past. A compilation made by the ELECTRICAL WORLD from data furnished by the steam turbine manufacturers discloses the fact that the volume of steam-turbine business already handled since the beginning of the current year exceeds 2,000,000 kw. in rated capacity. At this rate the total 1916 business should reach 3,000,00 kw. in turbine capacity.

The manufacturers, it was found, were loath to predict what the 1916 total would be. The volume of business depends entirely on what the manufacturers can turn out, the amount being practically limited to the capacity of factory facilities. At present the outlook for the balance of the year seems to be fairly good. There is a slight let-up in the total volume of business, but this is due entirely to deliveries.

At present the best deliveries that it is possible to obtain are eight months for some of the smaller sizes for pump and industrial use, a year to a year and a half on large industrial and ordinary central station sizes, and two years for the very large sizes. Orders now on hand are sufficient to keep the entire manufacturing facilities in operation for considerably more than a year.

The bulk of the year's business is coming from central stations, with an appreciable amount from industrial and marine installations. It has been roughly estimated that approximately 65 per cent of the present business is for central station equipment, 25 per cent for industrial plants, including marine installations, averaging 300-500 kw., and 10 per cent for pumping stations averaging 50 hp.

Many large units have been ordered since the beginning of the year. A statement from one prominent company expressed the opinion that this was because large central stations have purchased turbines. Another company called attention to the fact that the size of units ordered is larger than in the past, the tendency being to machines of very large capacity. Notable in this respect have been orders for a 73,000 hp. and a 60,000 hp. unit and an order for two cross-compound units of a total rating of 95,000 kw.

Both labor and material have been hard to obtain in satisfactory quantity and price, and both have greatly increased in price during the year. Turbine prices have, therefore, necessarily advanced.

Owing to the large volume of business deliveries are not normal, but are unusually long at present. This volume of business is attributed to the prevailing conditions and unusual industrial activity, and as long as the European war continues it is the opinion of at least one prominent manufacturer that the demand for steam turbines will be large.

FARMS GOOD MARKET FOR ELECTRICAL APPARATUS

Many Inquiies Have Been Received for Incubators, Hoovers, Churns, Separators and Other Dairy Apparatus—Excellent Prospects for Future

Electrical farm apparatus of the dairy and poultry types is each year finding a larger market. As a rule, trade in farm implements and equipment falls off along in June and does not pick up again until after the fall county fairs. In recent months, however, manufacturers of this class of electrical equipment have been receiving a large number of very promising inquiries.

The use of electricity on the farm has broadened considerably in the last few years. Many central stations have made a practice of extending their lines out through rural communities where the cost of service is not prohibitive. In addition, there has been a wide sale of farm generating units. From the standpoint of the central station, of course, the lighting load alone would not warrant the extension of this service in most cases. As a rule, the company sells its service because of the advantages offered by electric power for many different kinds of farm work. There has thus been created a large market for electrically operated farm equipment.

Motor-driven apparatus on the farm is not new. On the other hand, electrically heated apparatus has been in use but a short time. No stable market for electric incubators or hoovers has been developed as yet. It is pointed out by one manufacturer that much educational work is necessary before the public generally will appreciate the superiority of the electrically heated machine. In regard to the business of this product, this same manufacturer points out that there is every indication pointing to the conclusion that next season will find electric incubators and hoovers in strong demand. While the number in use at the present time he believes is insignificant, he also believes that in less than five years central stations of the United States will be deriving a highly profitable income from this source.

Owing to the increased cost of raw materials, and particularly that of electric motors, and to the increased labor costs, it has been found necessary by almost all manufacturers to advance the price of electrical farm apparatus. Deliveries have also been delayed to a certain extent, owing principally to the delayed deliveries of manufacturing material. Where motors are used this delay has been very serious. Collections and credit are generally good in this line of business, principally because farmers who buy this sort of apparatus are of the business man type and as such realize the necessity for a good credit standing.

VOLUME OF ORDERS DIMINISHING SLIGHTLY

Deliveries so Long that Feverish Buying Drops Off—Demand Still Large with Some Buyers Anticipating Requirements

After continuing for some months considerably greater than production the volume of orders have on the whole begun to show a slight decrease in total volume. Such an event was most everywhere expected, for it was pointed out that the volume of incoming orders could not continue long to be so much greater than production without the entire industry becoming swamped and tied up. However, the decrease in total volume has been slight, in fact much less than was anticipated.

Early last fall the industrial super-activity started, and as it progressed more people began to cover and anticipate wants and deliveries. As a result, factories began to fall behind the incoming business in the matter of production. Buying was on a tremendous scale. Additions that were made to factories were insufficient to thoroughly cope with the situation. Deliveries became longer and longer. Finally it seemed as though a limit were reached and buyers slowly became willing to wait for better conditions.

This slacking off in orders instead of being viewed with any alarm is being hailed almost with joy. As soon as the manufacturers can get down to normal activity, it is felt, the market will be in a more healthy situation. Of course, this situation does not exist all over the electrical manufacturing industry. Evidence of it, however, is unmistakable in the total volume of business.

RANGE PRODUCTION FOR 1916

Output Will Amount to $2,000,000—Price Trend Upward—$100 Range Proves Best Seller

The canvass of the electrical range field made by the ELECTRICAL WORLD last January indicated that manufacturers expected the electric-range production for 1916 to amount to about $1,000,000, based on manufacturers' selling prices. Now that the year is nearly three-quarters gone, and the busiest electric range season is past, it becomes evident that the output for 1916 will pass the $2,000,000 mark. That more central stations are beginning now to aprange, it is estimated that the annual revenue which will accrue to central stations from the 1916 output will be $360,000. That more central stations are beginning to appreciate the significance of the electric range as an off-peak load is undoubtedly one of the fundamental reasons why the actual production will be $2,000,000 instead of $1,000,000 at first expected.

Of the changing trade conditions, under which this output is being produced, many interesting things may be said. Electrical jobbers are becoming a greater factor in the business. The jobbers' place in the field is now an important one. It has been estimated that fully one-third of the 1916 production will be handled through jobbing houses. Price conditions are showing an upward trend. The more expensive types are finding readier sale than the less expensive ones. Instead of continuing as a summer specialty the range is becoming an all-year-round proposition.

Price conditions during the year, influenced by the raw material situation and the heating device patent situation, are unsteady. Increasing prices of raw material have already caused some range makers to increase list prices or to decrease discounts from established lists. There is little trouble in finding justification for such action when it is pointed out, for instance, that certain sizes of asbestos-covered copper wire, which formerly cost $5.60 per 1000 ft., is now being ordered for range construction at $61 per 1000 ft. This instance of price advance is only one of many. Metal prices have soared and prices of heat-insulating material have attained even greater heights. Furthermore, the material situation is also complicated by the fact that resistance wire is difficult to obtain at any price. The shortage of this product is attributed mainly to the inability of its producers to get suitable diamond dies for drawing the wire. To insure against further metal troubles, steel purchases in some quarters are being made eight months in advance. Opinions differ among manufacturers as to the effect of the licensing arrangement on price. The majority, however, seem to believe that an upward revision will be necessary after Oct. 15.

Strange as it may seem in the light of central station clamorings for cheaper ranges, the stoves that retail at about $100 seem to be enjoying the greatest demand. Those who have sensed this trend attribute it to the fact that the buying public no longer accepts the range as an experiment. They buy it as a permanent piece of home equipment. That the higher-priced equipment is finding favor augurs well for future continuity of electric cooking, since few people would care to scrap a $100 piece of household equipment.

Deliveries, which were slow during the summer, are now in better shape, partly because the peak of demand has passed, and partly because labor is less restive. Good workmen who could formerly be attracted to munitions plants by high wage offers are showing less disposition to change jobs. Consequently three weeks' deliveries are now being quoted in some factories.

With all the increased buying this year collections on ranges have been good. This condition generally prevails, however, since that part of the trade to which range manufacturers sell believes, as a rule, in discounting its bills, and generally has the cash with which to do so.

Manufacturing and Industrial

The Greenfield (Mass.) Tap & Die Corporation has discontinued its office in Detroit.

William S. Houston of Brazil, care of Companhia Commercio e Navegacao, 10 Bridge Street, New York City, will pay cash in New York City for electrical machinery and fittings.

The Economy Fuse & Manufacturing Company, Kinzie and Orlean Street, Chicago, Ill., has moved its Boston office to 636 Rice Building, 10 High Street, which will be in charge of R. S. Blake, who succeeds J. R. Wilkins.

Solomon I. Arnopulin of Siberia, care of Bureau of Foreign and Domestic Commerce, 504 Federal Building, Chicago, desires affiliations as representative of American manufacturers of electrical appliances in Siberia.

Large Automobile Storage Battery Business for U. S. Light & Heat.—The U. S. Light & Heat Corporation, Niagara Falls, N. Y., reports that it has recently obtained nearly $3,000,000 of new automobile storage-battery business.

The Nelson Valve Company and the **Yarnall-Waring Company** of Chestnut Hill, Philadelphia, Pa., announce the appointment of H. J. Moyer as their representative in Chicago. The companies have also opened an office in the Hearst Building.

Foreign Buyers in the United States.—Carlos Rodriguez of Buenos Aires, Argentina, care of LaPrensa, New York Herald, New York City, is desirous of securing the agency for American electrical supplies of all kinds, including electric motors.

Howard M. Gassman has recently opened offices at 720 Brown-Marx Building, Birmingham, Ala., and will act as a consulting mechanical and electrical engineer. Mr. Gassman was formerly chief electrical engineer of the Tennessee Coal, Iron & Railroad Company and is a graduate of Johns Hopkins and Lehigh Universities.

The Roller-Smith Company, 233 Broadway, New York, announces that it is now represented in Denver, Colo., by the O. H. Davidson Equipment Company, Ideal Building. This company will handle the Roller-Smith products in Colorado, Wyoming, New Mexico, Utah and parts of the states of Montana, Idaho, Arizona, Texas and South Dakota.

The Page Woven Wire Fence Company, Monessen, Pa., has appointed W. T. Kyle Eastern sales agent for its "Copperweld" copper-clad steel wire products, with offices at 30 Church Street, New York. Mr. Kyle has been connected with the Okonite Company in its sales department and for some time previous acted as Eastern sales manager for the Duplex Metal Company.

Order for Large Turbine.—A 20,000-kw., 11,000-volt, 25-cycle turbine unit complete with a 24,000-sq. ft. surface condenser and auxiliaries has recently been ordered by the Pennsylvania Railroad from the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. This turbine is for installation in the railroad's Long Island City power house, which supplies power for the operation of the Pennsylvania Terminal and the Long Island Railroad.

New Prices for Electric Appliances.—Landers, Frary & Clark, New Britain, Conn., announce that, owing to material advances in the cost of raw material, as well as various manufacturing operations, they find that on some of their principal lines the small advances which they made within the past year do not begin to cover adequately the increased cost of manufacture. They have, therefore, been compelled to revise their prices as per sheets which are being sent out to various dealers.

The Canadian General Electric Company, Toronto, has recently received an order for a 5000-kva. turbine from the Acadia Coal Company of Stellarton, Nova Scotia. The turbine is of the five-stage type and is designed to operate at 3000 r.p.m. The generator will deliver three-phase 50-cycle current. The electric company will also furnish condensers, pumps and all auxiliaries. The new turbine will operate in multiple with the coal company's existing turbines, furnished some time ago by the Allgemeine Electrictäts Gesellschaft of Berlin.

Conference on Co-operation.—The third annual Boston conference will be held on Sept. 13, 14 and 15 at Wellesley Hills, Mass., the subject this year being "Co-operation." D. B. Doremus, secretary, Salt Producers' Association, Ernest H. Gaunt, secretary and treasurer, Optical Manufacturers' Association, H. V. Spaulding of Grafton & Knight Manufacturing Company, Worcester, Mass., and H. S. Wales, secretary, Pressed Metal Association, will discuss "Co-operative Competition." N. O. Nelson Manufacturing Company, St. Louis, Mo., Dean S. S. Marquis, Ford Motor Company, Detroit, and Everett Morss, president, Simplex Wire & Cable Company, Cambridge, Mass., will discuss profit sharing as "Co-operation Between Employer and Employee."

No Attendant in Idaho Reclamation Pumping Station.—An interesting automatic control installation is in operation in the West End pumping stations of the Minidoka Reclamation Project, Idaho. The equipment consists of two 75-hp. Allis-Chalmers 2200-volt motors, two centrifugal pumps and automatic control apparatus installed by the Cutler-Hammer Manufacturing Company of Milwaukee. Water is pumped by this station to a height of 21 ft. above a gravity canal which irrigates 2200 acres of land under the Minidoka project. The station is operated without regular attention other than that given it by a ditch rider who sleeps in a room in the station at night. The control apparatus mentioned above automatically starts and stops the motors, and in case there is an interruption of power it is so designed as to bring the pumps back into service without any supervision. The pumps are in a pit with the runners below the surface of the water in the intake canal, and therefore are always primed.

Price of Platinum Up.—In the last ten days platinum has taken a leap in price. Quotations had been running around $60 an ounce but about the last of August prices rose to between $80 and $85 an ounce, depending on quality. Platinum dealers in New York gave the demand for the metal in this country as the cause for the increase. The bulk of the world's supply of platinum comes from Russia, but since the war the allied forces have been very careful of the destination of all stock of platinum. Its use in munition manufacture is so important that the Allies have been fearful, it is stated, that if a large supply went to a neutral nation some of it might find its way into Germany. As a result of the embargoes there is but a very limited supply in this country at the present time. A year ago platinum sold for $105 an ounce after England, France and Russia had placed the embargoes on the exportation of the metal. Some dealers are of the opinion that before this year is over these high prices will again have been reached.

Long Life of Cedar Poles.—Lindsley Brothers Company, dealers in Western and Northern cedar poles, have recently been looking up some of the poles they shipped in the Central West in 1899 with a view to ascertaining their present condition. They wrote to a number of concerns to whom they had furnished poles, asking them to report on the condition of their poles to-day. Replies in general indicate that poles set in 1899, 1900 and 1902 are in very good condition. One user reports: "We consider the remaining poles, 90 per cent of total, are still in very good condition and should last at least five years longer, before it is necessary to reinforce them." Another user at Louisville, Ky., states: "We have found the poles to be in good condition generally, some of them showing only 1 in. of rotten wood. Out of the total number, sixty, only four poles show an amount of rot which would seriously impair the strength of the pole. Out of the sixty poles, two were replaced in 1913, due to a dry rot at the top of the pole. The other fifty-eight are now in good condition above the ground and should last ten years at least." Another letter from Dallas, Tex., states: "About 60 per cent of the poles have been removed, not so much because of rot but rather on account of municipal regulation. These poles have been removed during the last three years, but would undoubtedly have been good for four or five years more. The probable life of the poles still standing is about five years." Letters were received from eight concerns, all of whom have had their poles from fourteen to sixteen years. The company also reports that in addition, a special representative inspected poles that were shipped to Grand Rapids in 1900. These poles were still standing in the line, apparently in as good condition as when first set. On close investigation,

however, rot was found just below the ground line, but not enough to weaken the pole in any way. The investigator, the company states, also found poles in Detroit which had been used since 1900.

Permissible Portable Electric Mine Lamps.—In accordance with Schedule 6A, the following portable electric mine lamps have been approved by the Bureau of Mines, Department of the Interior: Approval No. 10 covers a permissible portable electric mine lamp manufactured by the Edison Storage Battery Company, Orange, N. J. The only bulbs approved for use with this lamp are the symbol 26-V bulbs manufactured by the Independent Lamp & Wire Company, 1737 Broadway, New York City; the symbol BM-10 bulbs manufactured by the National Lamp Works of the General Electric Company, Cleveland, Ohio, and the symbol BM-10 bulbs manufactured by the Edison Works of the General Electric Company, Harrison, N. J. Approval No. 11 covers a permissible portable electric mine lamp manufactured by the Mannesman Light Company of America, 16 Pike Street, Tompkinsville, Staten Island, N. Y. The only bulbs approved for use with this lamp are the symbol C-5 bulbs sold by the Mannesman Light Company of America. Approval No. 12 covers the "Concordia" permissible portable electric mine lamp manufactured by the Concordia Safety Lamp Company, Fulton Building, Pittsburgh, Pa. The only bulbs approved for use with this lamp are the symbol "Osram" 08510 bulbs sold by the Concordia Safety Lamp Company. Approval No. 13 covers a permissible portable electric mine lamp, manufactured by the General Electric Company, Schenectady, N. Y., to be used with a flexible cord identified by the bureau's specification No. CD-21; and with the "Iron-Clad Exide battery" manufactured by the Edison Storage Battery Company, Philadelphia, Pa. The only bulbs approved for use with this lamp are the BM-13 bulbs manufactured by the Edison Lamp Works of the General Electric Company, Harrison, N. J. Approval No. 14 covers the "Wico" permissible portable electric mine lamp manufactured by the Witherbee Igniter Company, Springfield, Mass. The only bulbs approved for use with this lamp are the symbol BM-14 bulbs manufactured by the Edison Lamp Works of the General Electric Company, Harrison, N. J. Approval No. 15 covers the "Concordia" permissible portable electric mine lamp manufactured by the Concordia Safety Lamp Company, Pittsburgh, Pa. The only bulbs approved for use with this lamp are the BM-15 bulbs manufactured by the National Lamp Works of the General Electric Company, Cleveland, Ohio. Approval No. 16 covers the Pioneer permissible portable electric mine lamp manufactured by the Hirsch Electric Mine Lamp Company, Philadelphia, Pa., to be used with a flexible cord identified by the bureau's specification No. CD-31; and with battery plates manufactured by the Edison Storage Battery Company, Philadelphia, Pa. The only bulbs approved for use with this lamp are the BM-16 bulbs made by the Edison Lamp Works of the General Electric Company, Harrison, N. J. All approved electrical equipment is to be identified by a plate bearing the seal of the bureau and the statement and number of the approval. Equipment that is not so identified is not considered as approved.

NEW YORK METAL MARKET PRICES

	Aug. 29 Selling Prices Bid	Aug. 29 Selling Prices Asked	Sept. 5 Selling Prices Bid	Sept. 5 Selling Prices Asked
Copper	£ s d	£ s d	£ s d	£ s d
London, standard spot	110 0 0		109 0 0	
Prime Lake	27.00	to 27.50†	27.00	to 27.50†
Electrolytic	27.75	to 28.00†	27.50	to 28.00†
Casting	25.00	to 25.25†	25.00	to 25.25†
Copper wire	33.00†		33.00†	
Lead	6.50		6.50	
Nickel	45.00	to 50.00	45.00	to 50.00
Sheet zinc, f.o.b. smelter	15.00†		15.00†	
Spelter	8.92½	to 9.17½	8.80	
Tin, straits	39.37½		39.00	
Aluminum, 98 to 99 per cent.	58.00	to 60.00†	58.00	to 60.00†

OLD METALS

Heavy copper and wire	22.00 to 22.50†	22.00 to 22.50†
Brass, heavy	13.00 to 13.25†	12.75 to 13.00†
Brass, light	9.75 to 10.25†	9.10 to 10.50†
Lead, heavy	5.50 to 5.62½†	5.50 to 5.62½†
Zinc, scrap	6.50 to 6.75†	6.00 to 6.50

COPPER EXPORTS

Total tons to Sept. 5 ....

†Nominal.

Corporate and Financial

Chillicothe (Ohio) Electric Railroad, Light & Power Company.—The Ohio Utilities Company, which was organized at Columbus, Ohio, a short time ago with an authorized capital stock of $500,000, has made application to the State Public Utilities Commission to purchase the Chillicothe Electric Railroad, Light & Power Company for $480,000. It is proposed to consolidate this company with the electric light companies at Delaware, Circleville and Gallipolis. The company also asks authority to issue $750,000 6 per cent first mortgage bonds, $200,000 preferred stock with maximum dividends of 7 per cent, and $100,000 common stock. John J. Phillips, vice-president of the Chillicothe Company, is president of the new company. Eastern capital is said to be interested.

American Public Utilities Company, Grand Rapids, Mich.—In the annual report of the company for the year ended June 30, 1916, the directors say: "The operations of your company for the fiscal year ending June 30, 1916, were marked by growth in the volume of business done, an increase in net earnings applicable to interest and dividend purposes, and the presentation of a marked example of the difference between the stability of public service investments and those made in ordinary commercial operations. This stability reflects itself not only in the maintenance of volume of business and price of product during periods of commercial distress, but with as much distinctness as during periods of extraordinary activity. The prices of the service of public utility corporations being fixed, they do not participate so generously in the profits of good times as do other commercial operations. Their benefit from such conditions grows out of an increased volume of sales, a proportionate lowering of the percentage of overhead expense, and prompter collection of charges. Against these there are to be charged higher prices for raw materials and labor employed.

"All of these features have been characteristic of the business of your company during the year, indicating anew that for every given cycle, including periods of both stress and expansion, public utility investments are most nearly stable, experiencing neither the one extreme of hardship in bad times nor the other extreme of inflated income in good ones. The commercial activity of the various companies during the first six months of the fiscal year just closed was, to a considerable extent, hampered by somewhat unsatisfactory general conditions. The last six months of the period were marked by greater business activity, but were also accompanied by a notable advance in the prices of the metals entering into the construction and extension of public service properties. The high prices of iron and copper suggested to your directors the advisability of avoiding any wholesale program of extensions, their judgment favoring more active campaigns for business in the territories already occupied by the various subsidiaries. The wisdom of this program is reflected by its results. During the year the various gas plants were able to confine the laying of new services very largely to establish mains. They made a substantial net gain of meters in service, of which 25 per cent were placed on inactive services which had not been in use. The electric properties for the same period showed 9279 new services installed. Thus the largest possible amount of growth was realized without undue expenditures for an expansion of properties, involving the use of metals commanding abnormal prices."

The gross sales of all the companies for the fiscal year were $3,309,586.16. These, compared with gross sales of the previous year, amounting to $2,932,069.79, show an increase of 12.88 per cent in the volume of business done by the company's subsidiaries.

Two years ago, the report states, the American Public Utilities Company adopted the policy toward its subsidiaries of carrying the liability insurance of all of them, with a view to realizing a substantial economy in this department of expenditure. The first fiscal year's business was done on the basis of charging the subsidiary companies the rates which they had been accustomed to pay the stock companies providing them with such insurance. As a result of the first year's experience the sum of $16,563.84 was returned to the subsidiary companies. The second year's experience has been on the basis of a charge of one-half the

rates formerly paid to the stock companies for insurance. Despite the payment of $14,927.19 during the year from this insurance fund to injured employees and public claimants, a further return of $17,725.23 was made to the subsidiary companies, a substantial reserve being still retained. The earnings statement of the subsidiary companies for the twelve months ended June 30, 1916, follows:

Gross earnings from operations	$31,309,586
Operating expenses	1,842,802
Net earnings from operations	$1,466,784
Miscellaneous income	81,744
Gross income	$1,548,528
Less expense	39,437
Net income	$1,509,091
Fixed charges:	
Interest charges	1,114,018
Dividend on preferred stock	234,840
Balance	$160,233

Midland (Pa.) Electric Light & Power Company.—Under the name of the Midland Electric Light & Power Company, eleven electric light companies in western Pennsylvania have been merged as one corporation. They are the Ohio Township, Potter Township, Raccoon Township, Ferry, Georgetown, Mirland, Glasgow, Hanover, Hookstown, Independence and Industry light companies. The capital of the new company is $65,000. The officers are: President, S. L. Tone; vice-president, James D. Callery; secretary, W. B. Carson; treasurer, C. J. Braun, Jr.; comptroller, C. S. Mitchell, all of Pittsburgh.

U. S. Light & Heat Corporation, Niagara Falls, N. Y.—At the recent annual meeting of the stockholders the following board of directors was elected: Egbert H. Gold, J. Allan Smith, Ralph C. Caples, Henry W. Farnum, A. Henry Ackermann, Chauncey L. Lane, Keene H. Addington, James A. Roberts, Conrad Hubert, George G. Shepard and Edwin K. Gordon.

Worcester (Mass.) Electric Light Company.—The stockholders of the company at a meeting on Aug. 30 voted to issue 2000 shares of stock in accordance with the approval of the Massachusetts commission in July. The directors of the company voted to set Oct. 14 as the time for the payment of the new shares, which will be sold at $200 per share to stockholders of record.

New Utility and Industrial Companies

The Northern Utilities Corporation of Starkweather, N. D., has been organized with a capital stock of $25,000 by T. J. Daugherty, G. R. Jackson and J. Kurth.

The Loomis Electric Company of Akron, Ohio, has been incorporated with a capital stock of $10,000 by C. H. Loomis, C. E. Loomis, F. F. Loomis and others.

The Ho-Po Electric Company of Buffalo, N. Y., has been incorporated with a capital stock of $3,000 by Charles W. Hoppie, Fred C. Poland and Frederick A. James.

The Oklahoma Power & Light Company of Shawnee, Okla., has been incorporated with a capital stock of $25,000 by Sinclair Mainland of Oshkosh, Wis.; J. A. Hamilton of Merissa, Ill., and Edward Howell of Shawnee, Okla.

The United States Securities Company of Portland, Me., has been organized with a capital stock of $50,000 for the purpose of carrying on a general electrical and mechanical engineering business, etc. Fred F. Phillips of Portland, Me., is president and George H. Hinckley, clerk of the company.

The George West Water & Light Company of George West, Tex., has been incorporated by George W. West, S. S. Searcy and Charles Scheiner, Jr., all of San Antonio, Tex. The company is capitalized at $40,000 and proposes to construct and operate an electric light plant and water-works system.

The Fornes-Walters Company of Canton, Ohio, has been incorporated by G. F. Fornes, W. H. Burgener, Ray Walters and S. L. Fornes. The company is capitalized at $10,000 and proposes to do a general contracting business and in addition, it is understood, will deal in lighting and other electrical fixtures.

The James H. Carey Electrical Works of Portland, Me., has been incorporated with a capital stock of $10,000 to do a general electrical business. The officers are: Henry F. Merrill, president; Donald C. Kimball, treasurer, and Grover T. Davis, clerk, all of Portland, Me.

The United Battery Company has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $3,000,000. The company proposes to manufacture and deal in and with electric storage batteries. The incorporators are: G. C. Prerich, F. O. Balch of Chicago, Ill., and Marion Luce of Oak Park, Ill.

Trade Publications

Electric Grinder.—The Dillon Electric Company, Canton, Ohio, has issued a folder which is illustrated and which is descriptive of its motor-driven grinder.

Electric Heater.—The Pelouze Manufacturing Company, 232 East Ohio Street, Chicago, Ill., is sending out an illustrated leaflet descriptive of its new electric radiator.

Electric Equipment.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is sending out a new series of sections for its loose-leaf catalogs No. 3002 and No. 3001.

Gasoline Engine-Driven Generating Plant.—The Main Electric Manufacturing Company, Pittsburgh, Pa., has prepared an illustrated folder which contains information on its small farm lighting outfit.

Photograph Printer.—The Folmer & Schwing Division of the Eastman Kodak Company, Rochester, N. Y., has prepared an illustrated folder which describes its electrically-illuminated photograph printer.

Portable Vise Bench and Pipe Bender.—The Standard Iron Works, 540 West Fifty-eighth Street, New York, has issued an illustrated catalog which contains information on its portable vise bench and pipe bender.

Meter-Testing Device.—Circular No. 28, recently issued by The States Company, 19 New Park Avenue, Hartford, Conn., describes a "portable load" for testing alternating-current watt-hour meters by the rotating standard test-meter method.

Electricity in the Textile Industry.—The British Westinghouse Electric & Manufacturing Company, Trafford Park, Manchester, England, has prepared a folder designated as envelop series No. 4874A, which is entitled, "Electricity in the Textile Industry."

Alternating-Current Generating Sets.—Bulletin No. 200, just issued by Engberg's Electrical & Mechanical Works, St. Joseph, Mich., is entitled, "Alternating-Current Apparatus," and contains information on the company's engines and alternators.

Electric Coffee Grinder and Meat Chopper.—The Canton Electric Cut Company, Canton, Ohio, has prepared illustrated folders which are printed in colors and which describe several types of electrically operated coffee mills and motor-driven meat choppers.

Electrically-Illuminated "Porch Ball."—The Pennsylvania Glass & Manufacturing Company, 404 Diamond Street, Pittsburgh, Pa., is sending out an illustrated folder which contains information on its "Pennsy" porch ball, its glass canopy and shade and its mirrored window reflectors.

Centrifugal Pumps.—The Pelton Water Wheel Company, San Francisco, Cal., has issued illustrated Bulletin No. 9, which is descriptive of the Pelton-Doble centrifugal pump, the most notable feature of which is the uni-diffusion system of the volute, by means of which, it is claimed, high efficiencies are obtained.

Electrically Operated Toys.—The A. C. Gilbert Company, New Haven, Conn., has prepared a book entitled "Elementary Electricity for Study and Use with Erector Electrical Sets." The book is divided in sections—Volume 1, on static electricity and magnetism, Volume 2 on current electricity and Volume 3 on induction electricity. It also contains information on motor building, lighting, wiring and experiments.

New England

EDEN, ME.—The Maine Public Utilities Commission has rendered a decision approving the contract between the Bar Harbor and Union River Power Company and the town of Eden for street-lighting service. Through error this appeared under Eden, Mo., in the issue of Sept. 2.

FARMINGTON, MASS.—The route for the high-tension electric line from Farmingdale to Bath, Mass., a distance of about 30 miles, has been surveyed and poles are now being set. About 1200 poles are to be used. The line will be brought across the Kennebec River at Chopps Point in Woolwich to a point in the northern end of Farmingdale, for which high towers are now being erected.

MALDEN, MASS.—The Malden Electric Company is building a power distributing station one story high of brick and concrete construction which will cost about $5,000.

Middle Atlantic

DUNKIRK, N. Y.—Bids will be received by the board of education of the city of Dunkirk until Sept. 15 for construction of school building. Separate bids to be submitted on general contract, heating, plumbing and electric wiring. Plans may be secured at the office of the superintendent at High School. E. E. Joralemon of Buffalo, N. Y., is architect.

FREDONIA, N. Y.—The Central Heating Company of Fredonia has notified its customers that it is retiring from business and the village authorities have demanded the surrender of its franchise. The company formerly used the exhaust steam from the power house of the Dunkirk & Fredonia electric railway, but this has been sold to the Buffalo & Lake Erie Traction Company, and Niagara power has been substituted for steam generated energy. The franchise has been transferred to Henry L. Doherty & Company of New York, N. Y.

LOCKPORT, N. Y.—The City Council has entered into a contract with the Lockport Light, Heat & Power Company for lighting the streets of the city for a period of three years.

OGDENSBURG, N. Y.—Right-of-way arrangements for a new power transmission line to be extended to Ogdensburg by the Aluminum Company have been made by Charles I. Olmstead.

ALLENTOWN, PA.—An outline of plans for the establishment of a municipal electric-lighting plant has been submitted to the Borough Council by Bascom & Sieger, borough engineers.

CLAYSBURG, PA.—The Public Service Company, recently chartered with a capital stock of $5,000, will supply electricity in Greenfield Township, Blair County. Offices will be located in Claysburg.

EVERETT, PA.—The Everett Light, Heat & Power Company expects to start day service about Nov. 1. J. A. Covalt is manager.

NAZARETH, PA.—The Pennsylvania Utilities Company of Easton is closing a contract with the borough of Nazareth to light the streets of the borough. The arc and incandescent lamps now in use will be replaced with type C Mazda lamps. The borough is represented by James T. Rood of Easton, consulting engineer.

NEWBURY, PA.—The Philadelphia & Reading Railroad will build a new boiler plant at its local shops.

PITTSBURGH PA.—The Duquesne Light Company of Pittsburgh is erecting a transmission line to carry 66,000 volts to the Beaver Valley.

STROUDSBURG, PA.—The boroughs of Stroudsburg and East Stroudsburg are about to close contracts for lighting the streets of the two boroughs. The present arc lamps are to be replaced by various sizes of type C Mazda lamps. James T. Rood of Easton, Pa., is acting as consulting engineer for the two boroughs in this matter.

TITUSVILLE, PA.—Bids will be received by the city of Titusville, Pa., until Sept. 13 for furnishing material and installing an ornamental street-lighting system. Specifications may be obtained on application to W. M. Dame, city clerk.

NEWARK, N. J.—An appropriation of $217,000 has been authorized by the Common Council for lighting and electrical construction on the city streets during the coming fiscal year.

QUINTON, N. J.—The township committee has made a contract with the International Light, Heat & Power Company, owners of the Salem electric light plant, for a series of street lamps for the town. The feed lines will be run out from Salem, a distance of 3 miles, at once.

TRENTON, N. J.—Bids will be received by the New Jersey State Home for Girls until Sept. 13 for the installation of additional boiler equipment. Plans and specifications are on file at the office of commissioner of charities and corrections, State House, Trenton.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Sept. 13 for furnishing and installing lighting fixtures in the United States post office at Ashland, Ky.; United States post office at Batavia, N. Y.; United States post office at Elyria, Ohio; United States post office at Logan, Ohio; United States post office at Merrill, Wis.; United States post office at Middletown, Ohio; United States post office and custom house extension at Muskegon, Mich.; United States post office at Navasota, Tex.; United States post office at New Braunfels, Tex.; United States post office at Sidney, Ohio; United States post office at Tulsa, Okla., and United States post office at Washington, Iowa, in accordance with plans and specifications, copies of which may be obtained at the above office.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval station the following supplies: Brooklyn, N. Y., Schedule 58—3000 steel wire casting brushes; Schedule 67—three main feed water heaters; Schedule 68—five 120-volt, direct-current blowers; Schedule 45—one 10-hp. induction motor; Schedules 71 and 75—miscellaneous radio transmitting sets; Schedule 59—miscellaneous single-conductor wire, miscellaneous twin conductor wire; Schedule 57—miscellaneous copper bar, miscellaneous copper sheet. Charleston, S. C., Schedule 64—one locomotive crane and lifting magnet. Puget Sound, Wash., Schedule 43—one heavy duty engine lathe. Philadelphia, Pa., Schedule 65—one electric truck and crane; Schedule 56—miscellaneous chisels, sockets, gages, etc., miscellaneous micrometers and calipers. Norfolk, Va., Schedule 57—10,000 lb. brass tubing; Schedule 50—one electric arc welding and cutting outfit. Washington, D. C., Schedule 72—miscellaneous antennas, masts, transmitting sets, generators, etc.; Schedule 73—31 radio wave meters; Schedule 46—50 ¼-hp., 120-volt, direct-current motors, 300,000 lb. ingot copper; Schedule 74—126 radio receivers. Newport, R. I., Schedule 70—one 10-kw. electrolytic generator. Boston, Mass., Schedule 54—40 bells for motor boats. Applications for proposal blanks should designate the schedule desired by number.

North Central

DETROIT, MICH.—Bids will be received at the office of the board of education, 50 Broadway, Detroit, until Sept. 12, for construction of an annex to the Bishop School building, including mason work, carpentry work, heating, ventilating, plumbing and electric wiring. Bids may be submitted for the entire work and also for separate classes of the work. Plans and specifications may be seen at the office of Spier & Gehrke, architects, 1317 Chamber of Commerce Building, Detroit.

DETROIT, MICH.—Bids will be received at the office of the secretary of the board of education, 50 Broadway, Detroit, until Sept. 12 for the construction of a 20-room school house on the block bounded by Cicotte, McGraw, Pittsburg and Gilbert Avenues, including general mason work, general carpentry work, heating, ventilating and plumbing and electric wiring. Proposals may be submitted on the entire work and also on separate classes of the work. Plans and specifications may be seen at the office of Ammerman & McColl, Penobscot Building, Detroit, consulting engineers, and copies obtained upon deposit of $10.

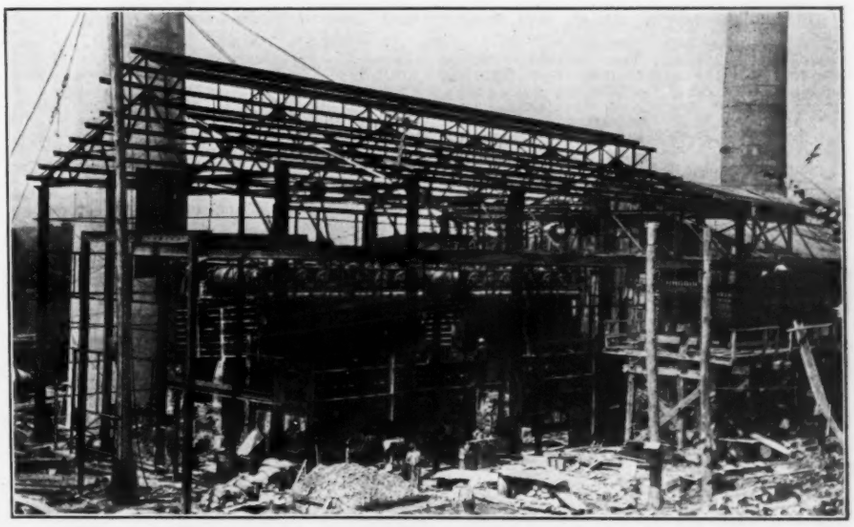
Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

New Plant of Clinchfield Portland Cement Corporation Nearing Completion at Kingston, Tenn.

The station structure of the new turbine plant addition for the Clinchfield Portland Cement Corporation at Kingsport, Tenn., is now four-fifths completed, and it is expected that the first of the two 4000-kw. steam-turbine units will be ready for operation by October. The illustration shows the steelwork being erected of the new boiler room. The four 600-hp. Edge Moor water-tube boilers are equipped with Foster superheaters and Detroit stokers, the flue gases being carried aloft through a reinforced concrete chimney 12 ft. in diameter and 225 ft. high. The feedwater will be heated by a pair of Cochrane open heaters with float control, and will be supplied to the boilers by a Worthington centrifugal pump driven by a Sturtevant steam turbine. The two main 4000-kw. generating units were furnished by the Allis-Chalmers Company, Milwaukee, Wis. Excitation current will be provided by two 75-kw. exciter generators, one driven by a steam turbine and the other by an induction motor made by the Wagner Electric & Manufacturing Company of St. Louis, Mo. The main turbine alternators are 6600-volt, 60-cycle, three-phase horizontal machines, designed to operate at 3600 r.p.m. on a steam pressure of 175 lb. per square foot, with a superheat of 125 deg. Fahr. The alternator elements are rated at 4000 kw. each, at 80 per cent power factor.

The new equipment described is being installed to supplement one 2500-kw. and two 750-kw. units, which are being remodeled. Messrs. Ford, Bacon & Davis, New York City, are consulting engineers for the Clinchfield Portland Cement Corporation and are supervising the construction of the new plant.



GRAND HAVEN, MICH.—The city of Grand Haven will erect a 6600-volt transmission line, 3 miles long, and also install a 200,000-gal. pump in the municipal plant. I. R. Ellison is city manager.

HAMBURG, MICH.—L. M. McCleary of Gregory, Mich., is contemplating the installation of an electric lighting system, the power to be furnished from a water-power site near here.

CINCINNATI, OHIO. — Committeemen from the towns of Cleves, North Bend and Addyston at meeting held recently at Addyston recommended the acceptance of the contract offered by the Union Gas & Electric Company for supplying electricity to the down-river towns, to be accepted by the three villages.

CLEVELAND, OHIO.—The National Acme Manufacturing Company, 7500 Stanton Avenue, has purchased from the Belt & Terminal Railway Company 15 acres near East 131st Street for $100,000, to be used as sites for additional factory buildings.

CLEVELAND, OHIO.—Contracts have been awarded by the Winton Hotel Company for the construction of a 550-room hotel at Ninth and Prospect Streets, to be known as Hotel Winton, to cost about $1,200,000. Contract for electrical work will soon be awarded. Wells Brothers of Chicago, Ill., are general contractors. N. M. Dunning of Chicago is architect.

CLEVES, OHIO.—The City Council has approved a contract with the Union Gas & Electric Company of Cincinnati to furnish 50 lamps of 80 cp. for a period of 15 years. The towns of Anderson and North Bend, it is reported, will petition the company to extend its service to those districts.

WEST PARK, OHIO.—Bids will be received by Fred Feuchter, village clerk, until Sept. 18 for construction of engine house on Lorain Avenue. Separate bids to be submitted on excavation, masonry, electrical work, heating, etc. Prices for labor and material must be stated separately.

MORGANFIELD, KY.—The consolidation of the Morganfield (Ky.) Light & Power Company and the Home Lighting Company of Uniontown is reported to be under consideration.

BREMEN, IND.—The city expects to change its pumping plant from steam to electric drive in the near future. Edward M. Wright is city clerk.

HANOVER, IND.—The Kent Light & Power Company of Hanover, recently incorporated with a capital stock of $3,000, proposes to establish an electric plant to supply electricity in Kent and other small towns in this section. James C. Reed and others are interested.

MULBERRY, IND.—The Mulberry Light & Power Company is preparing to extend its transmission line to Dayton, Ind. The company is also estimating on several other extensions. A. I. Yundt is treasurer.

BELLEVILLE, ILL.—Bids are being asked by the Board of Local Improvements for the installation of an ornamental lighting system, consisting of 73 cast-iron ornamental standards, steel taped cable, fuse blocks, switchboxes, wire, sockets, electric lamps, concrete bases, etc.

CHICAGO, ILL.—Bids will be received by the South Park Commissioners, Fifty-seventh Street and Cottage Grove Avenue, Chicago, until Sept. 15 for the construction of an underground system for lighting Michigan Avenue from Twelfth Street to Garfield Boulevard. J. F. Neil is secretary.

CHICAGO, ILL.—The Lincoln Park Commissioners are installing new lighting systems on several boulevards, comprising approximately 400 type C lamps, 400 cp., 15 amp., all operating on series-multiple transformers and underground circuits; also changing several direct illuminating installations to flood lighted type; contemplate enlargement of local telephone system and the installation of a 500-kva. turbo-generator unit. C. H. Shepherd is electrical engineer in charge.

CHRISTOPHER, ILL.—The property of the Tyrone Electric Company of Christopher has been purchased by the Central Illinois Public Service Company of Mattoon.

CLAYTON, ILL.—Surveys are being made by I. W. Fisk of Champaign for the purpose of furnishing an estimate for establishing an electric-light plant in Clayton.

EFFINGHAM, ILL.—The Eastern Illinois Utilities Company will make an increase in its capital stock of from $105,000 to $160,000. Improvements are contemplated.

GENESEO, ILL.—At an election held recently the citizens voted to issue $48,000 in bonds for construction of a municipal electric-light plant and distributing system.

HANOVER, ILL.—Bids will be received by the village of Hanover, Ill., until Sept. 12 for the construction of an electric distribution system. Plans and specifications may be obtained at the office of David G. Fisher & Company, Whitaker Building, Davenport, Iowa, upon deposit of $10.

MINER, ILL.—Two Murray engines of 50 hp. have been purchased for the municipal electric-light plant. Henry J. Blome is village clerk.

SAVANNA, ILL.—The Peoples' Gas & Electric Company of Savanna contemplates the erection of a high-tension transmission line between Savanna and Mount Carroll, a distance of about 12 miles.

BROADHEAD, WIS.—Plans are being considered by the Water and Lighting Commission for rebuilding the municipal power plant or erecting a new plant.

LAKE GENEVA, WIS.—The Wisconsin State Railroad Commission has granted the Southern Wisconsin Electric Company of Lake Geneva permission to issue $128,000 in bonds. The company, it is understood, contemplates extensions to its electric plant and lighting system.

UNION GROVE, WIS.—Bids will be received by the State Board of Control, Capitol Building, Madison, Wis., until Sept. 28 for heating apparatus, electric work, engines and fixtures for two custodial buildings and one 48-patient building, one superintendent's residence and farm dwellings at the Southern Home for Feebleminded and Epileptics at Union Grove. Separate bids to be submitted on heating and ventilating; interior electric wiring; pole line, transformers, switchboard, generators and exciters, engines, and lighting fixtures. Vaughn, Meyer & Sweet, Majestic Building, Milwaukee, are engineers. J. O. Davidson is president of board of control.

BENSON, MINN.—The Municipal Light & Water Board is contemplating changing the system of the municipal electric-light plant from direct to alternating current system by next year or selling the plant. The Otter Tail Power Company of Fergus Falls is negotiating for the purchase of the system. Theodore K. Lee is superintendent.

ECHO, MINN.—The city is figuring on installing in its municipal plant a 30-50-hp. crude oil engine in the near future and it is also thought possible that the system may be changed to alternating-current.

FAIRMONT, MINN.—Bids will be received until Sept. 14 by the Church of St. Paul for the erection of a convent school. Separate bids to be submitted for wiring, plumbing, etc. George Pass & Son, of Mankato, are architects.

HENDRUM, MINN.—The Village Council is considering the question of installing an electric-lighting system in Hendrum.

HIBBING, MINN.—Plans are being prepared by the Charles L. Pillsbury Company, Metropolitan Building, Minneapolis, for the construction of a concrete steel and brick building, about 100 ft. square, for municipal power plant at Hibbing. Complete new equipment, it is understood, will be installed.

HOFFMAN, MINN.—An election will soon be called to submit to the voter the proposal to issue $10,000 in bonds for the installation of an electric-lighting system. It is proposed to erect a transmission line from Barrett to Homan.

HOFFMAN, MINN.—Bids will be received by the village clerk, Hoffman, Minn., until Sept. 20 for furnishing materials and erecting an electric transmission line and distribution system in the village of Hoffman. Plans and specifications may be obtained at the office of the village clerk, Hoffman, and at the office of Earle D. Jackson, Capital Bank Building, St. Paul, Minn.

PIPESTONE, MINN.—The Northwestern Light & Power Company of Pipestone is contemplating the erection of a transmission line to supply electricity in Edgerton, Woodstock, Jasper and Trosky.

ROCHESTER, MINN.—The installation of a pumping station, motor-driven pumps and additional artesian wells, to cost about $35,000, is under consideration. The Charles L. Pillsbury Company of Minneapolis has charge of the engineering work.

SAUK CENTER, MINN.—Bids will be received by the city of Sauk Center until Sept. 12 for construction of an electric-light plant and addition to water-works system. The proposed work will include electric station equipment, resetting present motor-driven water-works pumps and furnishing and erecting a 500-gal. motor-driven fire pump, a pole line and ornamental street-lighting system. J. F. Cooper is city clerk.

ST. PAUL, MINN.—The City Council has approved the report of the commissioner of finance for the installation of an ornamental lighting system on the Mississippi River Boulevard from westerly city limits to a line located 445 ft. north of Summit Avenue. The cost is estimated at $3,850.

ST. VINCENT, MINN.—The Pembina (N. D.) Light & Power Company has been granted a franchise to erect an electric transmission system in the village of St. Vincent.

SPRINGFIELD, MINN.—The installation of an ornamental lighting system, covering eight blocks, is contemplated by local business men.

WABASSO, MINN.—The contract for the erection of an electric transmission line from Lamberton to Wabasso has been awarded to the People's Electric Light & Power Company of Lamberton.

CEDAR RAPIDS, IOWA.—The Iowa Electric Company of Cedar Rapids contemplates the erection of a high-tension transmission line from Iowa City to Iowa Junction.

DES MOINES, IOWA.—The Des Moines City Railway Company is asking for bids for the reconstruction of power station, two-story and basement, 110 ft. by 180 ft. The equipment will include one 1000 and one 5000-kw. generator units.

LITTLEPORT, IOWA.—Schmidt Brothers & Company of Elkader has applied for a franchise to supply electricity in Littleport. The company proposes to erect a transmission line from Elkader to Littleport.

ROCKWELL CITY, IOWA.—The general contract for construction of administration building and pathology buildings, power house and heating tunnel for Industrial Refuge for Females (owned by the State of Iowa) has been awarded to the Bailey-Marsh Company, Metropolitan Life Building, Minneapolis, Minn., and for electric wiring to the Citizens Electric Company, 215 Ninth Street, Des Moines, Iowa.

ROCKPORT, MO.—Charles L. Hamer and O. W. Clifton have applied for a 20-year franchise to supply electricity in Rockport. They propose to purchase the municipal electric-light plant if granted a franchise.

ST. JOSEPH, MO.—The Board of Public Works has authorized the bond election called for Sept. 26 held up. A commercial electric plant is under consideration.

ST. JOSEPH, MO.—Approximately $200,000 will be needed for improvement and extensions to the municipal electric-light plant according to a statement submitted by F. L. Hanush, chairman of the committee appointed by the Commerce Club. The estimate calls for an expenditure of $85,000 for improvements to plant, $15,000 for lamp standards for the ornamental lighting system and $8,000 for about 275 new lamps. The proposal to issue $85,000 in bonds for improvements to the plant will be submitted to the voters at the next election. Further investigations will be made before additional bonds are authorized.

ST. LOUIS, MO.—The Wintergarden Ice Company has been granted a permit to erect a two-story power plant at 5663 Kingsbury Boulevard, to cost about $12,000.

BERTHOLD, N. D.—Application has been made by the Northern States Power Company for a franchise to supply electricity in Berthold.

FARGO, N. D.—Plans are being prepared by F. L. Anders, city engineer, for the installation of an ornamental lighting system.

FARGO, N. D.—Bids will be received by A. R. Watkins, city auditor, for installing mechanical stokers or smoke eliminating and fuel saving devices in boiler furnaces of waterworks pumping station.

MUNICH, N. D.—Plans are being considered by O. J. Anthony and others for the installation of an electric-lighting plant in Munich.

PAGE, N. D.—The local electric-light plant, owned by W. J. Thompson, has been purchased by F. E. Davis.

WALHALLA, N. D.—The electric-light plant of the Walhalla Roller Mill Company was recenty destroyed by fire, causing a loss of about $50,000. Two generators and switch board were completely destroyed.

WORTHING, S. D.—William F. Donahue of Worthing has been granted a franchise by the Town Council to install and operate an electric-light plant here for a period of 20 years.

BURCHARD, NEB. — Bonds to the amount of $4,000 have been voted for the erection of an electric transmission line and distribution system. Energy will be secured from Summerfield, Kan.

OMAHA, NEB.—The date for receiving bids for furnishing plans and specifications for municipal electric-light plant has been postponed to Sept. 18.

HERINGTON, KAN.—Work has started on the construction of the power plant of the Chicago, Rock Island & Pacific Railway Company of Chicago, Ill., at Herrington, to cost from $40,000 to $50,000. The proposed plant will supply power for all the shops of the railway company.

HOXIE, KAN.—Bids will be received at the office of E. A. Montieth, city clerk, Hoxie, until Sept. 20 for construction of a municipal electric-light plant, separate bids to be submitted as follows: (1) Internal combustion engines complete on foundations built under separate contract; bid will be received one 50-hp. and one 25-hp. engine, the city reserving the right to accept either or both bids; also one 10,000-gal. fuel oil tank; (2) one 37½ and one 25-kw., three-phase, 60-cycle, 2300-volt alternator, constant current transformer, switchboard, and all station equipment, the city reserving the right to accept either or both bids; (3) furnishing all material for all transmission lines; (4) furnishing material and labor for erecting foundations; generators and station equipment and every thing connected with transmission lines; (5) furnishing material and constructing power house, cistern and cooling tower. George P. Taylor of Stockton, Kan., is engineer.

MORAN, KAN.—At an election to be held Sept. 18 the proposal to issue $12,000 in bonds for an electric-light plant and $30,000 for water-works system will be submitted to the voters. W. B. Rollins & Company. Railway Exchange Building, Kansas City, Mo., are engineers.

TOPEKA, KAN.—Additional equipment, consisting of a 250-hp. Ridgway engine, directly connected to a 150-kw. generator, replacing two smaller generators driven by an 85-hp. engine, is being installed in the power plant which supplies electricity and steam to the State Capitol Building, the Memorial Building and the State printing plant. Thomas L. Brown is manager.

WAKEENEY, KAN.—New equipment, including one 75-hp. oil engine, two 60-kw., 2300-volt generators and one five-panel switchboard complete, has been purchased for the municipal electric-light plant and will be installed within the next 60 days. H. C. Johnson is manager.

Southern States

COMMERCE, GA.—At an election held recently the proposal to issue $10,000 in bonds for the purchase of the electric distribution system of the Harmony Grove cotton mills was carried.

MICANOPY, FLA.—The Electric Light Department is erecting a three-phase, 2300-volt transmission line to McIntosh, a distance of 7 miles, for the purpose of supplying electricity to that municipality. J. E. Gates is superintendent.

BARTLESVILLE, OKLA.—Plans are being prepared by W. K. Palmer Engineering Company, of Kansas City, Mo., for the construction of an electric interurban railway to connect Bartlesville with Nowata, Welch or Blue Jacket and Miami, a distance of about 70 miles. D. F. Mason and F. M. Overless of Bartlesville are interested.

BLACKWELL, OKLA.—At an election to be held Sept. 12, the proposal to grant a franchise to the Oklahoma Railway Company to construct and operate an electric railway in Blackwell will be submitted to the voters. The City Council has also authorized the calling of an election to vote on the proposal to issue $35,000 in bonds for extension to the municipal electric-light plant and water-works system.

HOUSTON, TEX.—Bids will be received until Sept. 13 for lighting system for Harris County School for Boys as follows: (1) Lighting system; (2) wiring and necessary appliances; (3) lighting fixtures. For further information address H. L. Washburn, county auditor.

TERRELL TEX.—The Texas Power & Light Company has completed the erection of a high-tension transmission line from Dallas to Terrell. Connection will soon be made with the plant of the Terrell Electric Light Company. The company is also negotiating for the purchase of the municipal electric plant in Terrell.

VERNON, TEX.—Improvements, consisting of the installation of a new 25-hp. internal combustion engine, one double suction centrifugal pump with a capacity of 150 gal. per minute, and a generator of sufficient output to maintain 200 lamps of 100 cp., will be made to the municipal electric-light plant.

Pacific States

ARLINGTON, WASH.—Articles of incorporation have been filed by the Washington Coast Utilities Company, which recently took over the properties of the Jim Creek Water, Light & Power Company of Arlington, and the Stanwood Lighting system at Stanwood. The new company is capitalized at $100,000 and proposes to supply electricity, gas and water for municipal, industrial and commercial purposes. The principal place of business will be in Arlington. Warner Marshall, Shirley Philbrick of Boston, Mass., and Charles E. Shepard of Seattle, Wash., are the incorporators.

SEATTLE, WASH. — The Snoqualmie Falls Lumber Company of Seattle has placed orders for equipment for a logging and sawmill plant, to be equipped with electrically driven machinery. The equipment will include four 750-hp. Sterling boilers, designed to burn wet sawdust and shavings; one 4000-kw. and one 200-kw. condensing turbine, which will supply electricity for 300 motors at the mill and for the logging engines to be supplied over the transmission line. Contracts have also been placed for four electrically driven yarders and four loaders; the ultimate capacity, it is expected, will be twice this number. The most remote portion of the timber limits is about 15 miles from the mill; it is estimated that about 26 miles of transmission lines will be required to cover the entire area to be logged. At the outset the transmission line will be about 6 miles long and will be operated at 13,200 volts. W. W. Warren is manager of the company and A. H. Onstad, designing architect.

SPOKANE, WASH.—The Spokane Heat, Light & Power Company, successor to the Merchants Heating Company, has recently purchased a lot, 100 ft. by 142 ft., adjoining its property on Railroad Avenue, providing space for future extensions of the plant. The company is now installing a battery of ten boilers. Harry A. Flood is president.

PORTLAND, ORE.—Bids will be received at the office of the purchasing agent of the city of Portland, Ore., Room 208, City Hall, until Sept. 14, for a mechanical device for cleaning sewer inlets. Alternate proposals to be submitted on a rental basis for at least six months: rent paid to apply on purchase price. J. R. Wood is purchasing agent.

BAKERSFIELD, CAL.—Bids will be called Sept. 7 for a transmission line for the Southern Sierras Power Company.

LOS ANGELES, CAL.—The City Council has authorized the installation of electric lamps and electric energy furnished for one year on Adams Street, between Figueroa and Hoover Streets.

LOS ANGELES CAL.—The Public Service Board, co-operating with E. F. Scattergood, chief electrical engineer, is making preliminary negotiations with the city of Pasadena for interchange of power. The object is to make arrangements for the interchange of power for the municipal distribution system which is constructed in the Highland Park and Garvanza districts from the Pasadena municipal electric plant until the completion of the transmission lines from the Owens River project, under construction.

OROVILLE CAL.—A crew of surveyors for the Great Western Power Company has been in the field east of this place lately surveying for the second tower line to be constructed by the company.

REDDING, CAL.—No bids were received for the installation of the second unit of the municipal street-lighting system. It has been decided to do the work by day labor under the supervision of the engineer of the street department.

SACRAMENTO, CAL.—The establishment of a municipal electric-light plant in Sacramento is under consideration.

UPLAND, CAL.—The hydroelectric plant of the Pacific Electric Railway Company at Upland was recently destroyed by fire, causing a loss of about $20,000.

YERKA, CAL.—Surveys are being made by the California-Oregon Power Company extension of transmission line between Shasta Springs and McCloud, a distance of 7 miles. The company is also erecting an extension from Castella to Carville and Trinity Center.

BURLEY, IDAHO.—Reported that at a recent election bonds in the sum of $200,000 for the construction of a city hall, waterworks and municipal lighting plant were voted.

HAILEY, IDAHO.—The old electric plant of the Hailey Electric Company, which has been closed down for several months is being reconstructed and enlarged. New equipment including two transformers, switchboard, turbine wheel, exciter, regulator, lightning arresters, etc., are being installed. E. W. Rising is manager.

KINGMAN, ARIZ.—Application has been made to the Board of Supervisors by George H. Thayer of Kingman for a franchise to erect transmission lines into a number of towns and mining camps in Mojave County. Mr. Kingman is reported to be interested in a company which proposes to construct a hydroelectric plant on Burro Creek.

DENTON, MONT.—Investigations are being made by the Montana Power Company of Great Falls in Denton with a view of installing an electric-lighting system here.

DRUMMOND, MONT. — The Granite County Power Company, it is reported, contemplates erecting a 6600-volt transmission line from its plant at Maxville to Drummond.

LAUREL, MONT.—The City Council is reported to be contemplating the creation of a lighting district for the installation of cluster lamps, the work to be done this fall.

MILESTONE, MONT.—Steps have been taken by the Town Council toward the creation of two improvement districts and it is proposed to issue $6,000 in bonds for the establishment of a municipal electric-light plant in connection with the pumping station.

Canada

LETHBRIDGE, ALTA.—The ratepayers on Sept. 15 will vote on a by-law providing for further extensions to the electric-lighting system.

NEW WESTMINSTER, B. C.—The City Council has authorized the arc-lamp street-lighting system changed to the nitrogen lamp. George Digby is electric light superintendent.

ST. JOHN, N.B.—The installation of a complete new lighting system for the city is under consideration by the Department of Public Safety, which it is proposed to have in operation this fall. The plans provide for replacing the 372 arc lamps and 97 100-watt lamps now in use with between 600 and 650 new nitrogen lamps both 600 and 300 cp.

ALMONTE, ONT.—The Town Council is considering the construction of a hydroelectric plant, to cost about $18,000.

DUTTON, ONT.—The extension of the hydroelectric transmission line from Dutton to Wallacetown is under consideration.

ELMWOOD, ONT.—The Village Council is considering the installation of a hydroelectric power and lighting system. For further information address M. A. McCallum.

TORONTO, ONT.—Plans are being prepared by the Ontario Hydroelectric Power Commission for radial railways to cost about $25,000,000. Plans have been approved for a railway between Hamilton and Toronto. The Toronto terminals will cost about $7,000,000.

NOKOMIS, SASK.—The installation of an electric-light plant in Nokomis is under consideration.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Sept. 21 for furnishing garbage incinerator plant, galvanized sheet steel, hand pumps, lathe chuck, power drill, feed jointer, lathe, bandsaw machine, hub boring machine, bushings, flanges, etc. Blanks and general information relating to this circular (No. 1078) may be obtained from the above office or the office of the assistant purchasing agents 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

Underground Mains, and other engineering articles, together with the regular departments.

1,195,981. Electric Distribution with Low-Tension Magnetos; Victor Des Roches, Fond Du Lac, Wis. App. filed Feb. 14, 1916. For Ford cars—uses storage battery.

1,195,982. Signal Device; P. G. Donovan, Edgewood, Pa. App. filed Aug. 21, 1916. Combined electric and pneumatic, for railway trains.

1,196,013. Electric Signaling System; C. P. Nachod and F. W. Kulicke, Philadelphia, Pa. App. filed March 12, 1912. For electric railways.

1,198,044. Wrapping Machine; W. C. Stevens, Akron, Ohio. App. filed Aug. 19, 1912. For wrapping coils of wire.

1,196,062. Wire Splicer; M. P. Wolcott, Mansfield, Ohio. App. filed April 12, 1915. Includes construction for trolley wires.

1,196,071. Motor Control System; H. L. Beach, Edgewood Park, Pa. App. filed June 29, 1914. Automatic acceleration and retardation.

1,196,124. Motor Control System; W. O. Lum, Wilkinsburg, Pa. App. filed Oct. 3, 1913. Cuts out starting resistor in predetermined manner.

1,196,125. Motor Control System; W. O. Lum, Wilkinsburg, Pa. App. filed March 21, 1914. Automatic acceleration for use in blooming mills.

1,196,154. Control of Alternating-Current Motors; E. Rosenberg, Altrincham, England. App. filed Jan. 15, 1913. Avoids disadvantages of "cascade" arrangements.

1,196,160. Sewing Machine; F. E. Schoolfield and J. C. Owen, Bellevue, Ky. App. filed June 14, 1915. Electromagnets operate various mechanisms of the machine.

1,196,172. Control System for Electric Motors; W. Sykes, Pittsburgh, Pa. App. filed Jan. 10, 1912. Concurrent acceleration of two hoisting motors.

1,196,175. Thermostatic Control for Electric Heating Devices; J. Templeton and G. E. Harrison, Toronto, Ontario. App. filed March 6, 1916. Control of electric radiators.

1,196,398. Telephone Key; P. O. Robinson, Concord Junction, Mass. App. filed April 3, 1915. For effecting party line connections.

1,196,186. Electric Railway Vehicle; K. Von Kando, Vado Ligure, Italy. App. filed Dec. 9, 1914. Has rising and falling frame carrying the large high-tension insulators.

1,196,189. Block Signaling System; C. W. Ward, Lakewood, Ohio. App. filed July 12,1912. For single-track electric railways.

1,196,202. Apparatus for Preventing Sintering in Electric Furnaces; E. S. Berglund, Trollhattan, Sweden. App. filed April 21, 1915. Moves the charge after its introduction into the furnace.

1,196,211. Signal Apparatus; H. Csanyi, N. Y. App. filed July 6, 1914. Annunciator in which one signal operates on failure of other signal.

1,196,223. Method of and Apparatus for Testing Magnetic Objects; F. P. Fahy, Washington, D. C. App. filed Jan. 7, 1915. Instrument of precision for measuring magnetic characteristics.

1,196,225. Dry Cell; M. A. Foos, Fremont, Ohio. App. filed April 26, 1915. Sealing of carbon electrode.

1,196,242. Block-Signal System; U. S. Jackson, Lowell, Mass. App. filed May 12, 1914. "Normal danger" system with no parts to be actuated by moving train.

1,196,249. Tire-Unwrapping Machine; J. Kosutz and J. Bunta, Akron, Ohio. App. filed Oct. 27, 1915. For wrapping or unwrapping tires or similarly shaped objects.

1,196,254. Starting Device for Electric Motors; B. T. McCormick, Montreal, Quebec, Canada. App. filed Feb. 21, 1912. Resistance of maximum value and minimum weight and space.

1,196,270. Magneto Drive for Internal Combustion Engines; J. A. Ostenberg, Campbell, Cal. App. filed Sept. 13, 1915. Automatic advance and retard, and starts at low engine speed.

1,196,272. Insulator Pin; C. L. Peirce, Jr., Pittsburgh, Pa . App. filed Dec. 18, 1912. Thimble construction for high-tension wires.

1,196,273. Crossarm Saddle; C. L. Peirce, Jr., Pittsburgh, Pa. App. filed April 6, 1916. For seating metal insulator pins on wooden crossarms.

1,196,277. Loading Coils for Phantom Circuits on Aerial Lines; H. B. M. Pleuel and A. H. Olsson, Stockholm, Sweden. App. filed April 27, 1914. Removes eddy currents.

Record of Electrical Patents

Notes on United States Patents issued August 29, 1916, prepared by Mitchell & Allyn, 41 Park Row, New York.

1,196,299. Means for Minimizing Inductive Interference; C. F. Scott, New Haven, Conn. App. filed Jan. 2, 1915. Limits the current flow from substations remote from the moving vehicle.

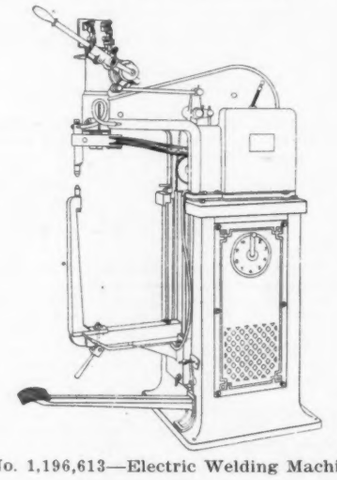
1,196,300. Means for Minimizing Inductive Interference; C. F. Scott, New Haven, Conn. App. filed Jan. 2, 1915. Confines return trolley car to the track rails.

1,196,301. Means for Minimizing Inductive Interference; C. F. Scott, New Haven, Conn. App. filed Jan. 2, 1915. Eliminates insulating joints in the trolley conductor.

1,196,302. Means for Minimixing Inductive Interference; C. F. Scott, New Haven, Conn. App. filed Jan. 2, 1915. Certain portions of tracks connected in parallel relationship and inductively interlinked with the trolley.

1,196,303. Means for Minimizing Inductive Interference; C. F. Scott, New Haven, Conn. App. filed Jan. 2, 1915. Inductively interlinks all power circuits.

1,196,304. Electric Welding Machine; F. L. Sessions, Lakewood, Ohio. App. filed May 7, 1913. For tube welding.



No. 1,196,613—Electric Welding Machine

1,196,308. Cam Mechanism for Wood Screw Machines; H. L. Smith, Waterbury, Conn. App. filed Sept. 17, 1915. More efficient construction for controlling the feed of the tool.

1,196,313. Electric Cell; W. Tassin, deceased, Washington, D. C. App. filed Jan. 18, 1915. Constant discharge rate.

1,196,323. Telephone Signaling System; J. S. Allen, Chicago, Ill. App. filed Oct. 16, 1913. Single ring-back for plurality of operator's cord circuits.

1,196,335. Recorder; A. A. Clokey, Jersey City, N. J. App. filed Feb. 2, 1915. For fire alarm systems, etc., adopted for location in panel of a switchboard.

1,196,340. Receiver Operated Switch for Telephones; H. D. Currier, Chicago, Ill. App. filed Dec. 8, 1913. For holding a "head" type receiver.

1,196,345. Ventilating Means for Dynamo Electric Machines; A. B. Field, Pittsburgh, Pa. App. filed Aug. 2, 1913. Designed for turbo-generators.

1,196,367. Time Clock; J. Kaup, St. Louis, Miss. App. filed Sept. 1, 1915. For signaling, "starting" and "quitting."

1,196,381. Dry Battery; M. H. Moffett, Lakewood, Ohio. App. filed June 9, 1916. Space for storing a lamp between the four cells.

1,196,401. Electrical Musical Instrument; M. L. Severy and G. B. Sinclair, Arlington Heights, Mass. App. filed Jan. 31, 1913. Plurality of sets of tuned strings actuated through a single key manual (seventy-four claims).

1,196,429. Signaling Apparatus; T. Bruger, Frankfort-on-the-Main, Germany. App. filed Feb. 9, 1911. Utilizes out-of-place currents for transmitting signals to a distance.

1,196,452. Method of Producing Unidirectional Electric Sparks from Alternating Current; C. H. Gaunt, San Francisco, Cal. App. filed May 18, 1914. For X-ray and wireless operations.

1,196,472. Meter Testing Device; T. E. Murray, Jr., and F. V. Magalhaes, New York, N. Y. App. filed Nov. 17, 1915. Special test plugs for watt-hour meters.

1,196,473. Electrical Welding; T. E. Murray, New York, N. Y.; App. filed Feb. 18, 1916. Butt-welding a tube to a plate.

1,196,474. Vacuum Tube Device; A. McL. Nicolson, Tarrytown, N. Y. App. filed Oct. 27, 1914. Compact construction for high-power circuits.

1,196,475. Trolley Wire Support; E. W. Nitzsche, Newark, N. J. App. filed Dec. 11, 1914. Permits flexibility of the trolley wire.

1,196,482. Automatic Selector Switch; J. N. Reynolds, Greenwich, Conn. App. filed Jan. 3, 1916. Brushes driven in both directions by single continuous moving member.

1,196,487. Electric Water Heater; M. Simon, St. Louis, Mo. App. filed Dec. 7, 1915. Coils disposed in tortuous chambers.

1,196,494. Speedometer; G. S. Tiffany, Summit N. J. App. filed Oct. 24, 1914. Movable indicating element in inductive relation to the magnet.

1,196,498. Metal Working; F. M. Vogel, Pittsfield, Mass. App. filed Aug. 10, 1914. Passes current through flanges that must stretch in bending of angle shapes.

1,196,511. Machine for Generating Electric Current; H. E. Borger, Dayton, Ohio. App. filed Nov. 27, 1914. Passes electrically conducted fluid through a magnetic field.

1,196,516. Speedometer; A. A. Canton, New York, N. Y. App. filed Oct. 29, 1914. Has means for governing relation of resistance in circuit.

1,196,528. Selecting System; A. F. Dixon, Newark, N. J. App. filed March 19, 1914. For printing telegrams.

1,196,532. Automatic Telephone Exchange System; B. G. Dunham, Hawthorne, N. J. App. filed June 7, 1915. Two-wire system.

1,196,541. System of Distribution; L. Hagood, Schenectady, N. Y. App. filed Oct. 3, 1912. Practically constant power factor.

1,196,544. Method of Coating Metal With Metal; F. W. Heuser, Gross-Lichterfelde, West, near Berlin, Germany. App. filed April 2, 1915. Practically for replacement of worn parts of rail heads.

1,196,562. Telephone Instrument; H. E. Lynch, Brooklyn, N. Y. App. filed April 9, 1915. Combined transmitter and receiver.

1,196,569. Push Contact Switch; E. A. Manville, Ansonia, Conn. App. filed March 13, 1915. Particularly for automobiles.

1,196,611. Primary Cell; W. Tassin, deceased, Washington, D. C. App. filed June 19, 1914. Maximum strength and durability with minimum size and weight.

1,196,613. Electric Welding Machine; A. C. Taylor, Warren, Ohio. App. filed June 26, 1913. Spot-welder.

1,196,618. Regulating Means for Electric Generators; W. A. Turbayne, Niagara Falls, N. Y. App. filed April 27, 1914. For charging train lighting storage batteries.

1,196,633. Electric Switch; C. E. Anderson, Bridgeport, Conn. App. filed May 29, 1915. Double push-button structure.

1,196,636. Electric Starting System for Internal Combustion Engines; V. G. Apple, Dayton, Ohio. App. filed Nov. 19, 1914. Foot switch for changing dynamo over to motor and vice versa.

1,196,637. Switch; V. G. Apple, Dayton, Ohio. App. filed April 14, 1915. Plunger operated with pairs of pivoted knife blades.

1,196,662. Electric Switch; G. A. Cherbrou and S. A. Lemp, Paris, France. App. filed April 20, 1914. Operated by "rocking dolly."

1,196,674. Alarm System; W. H. Gabel, Kintyre, N. D. App. filed July 3, 1915. Not rendered inoperative by cutting of the wires.